

**Agriculture in Brazil and Argentina: Developments and Prospects for Major Field Crops.** Randall D. Schnepf, Erik Dohlman, and Christine Bolling. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, Agriculture and Trade Report. WRS-01-3.

## Abstract

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Recent increases in international competitiveness by Argentine and Brazilian grain and oilseed producers could foreshadow continued gains on the strength of abundant undeveloped agricultural resources, increasing market orientation, and expanding global trade liberalization. Economic and policy reform coupled with agricultural research developments drove the dramatic growth surge of the 1990s. Infrastructure development, livestock sector dynamics, and macroeconomic stability in each country will determine the speed and intensity of further growth.

**Keywords:** Brazil, Argentina, soybeans, corn, wheat, agriculture, policy, infrastructure, production costs

## Acknowledgments

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The authors thank Mark Ash, Praveen Dixit, Joy Harwood, Demcey Johnson, William Kost, Dale Leuck, William McBride, Greg Pompelli, and Jim Stout of the Economic Research Service; Carol Goodloe of the Office of the Chief Economist; Gerald Bange, Keith Menzie and Shayle Shagam of the World Agricultural Outlook Board; David Mergen, Marc Lower, and Eric Wenberg of the Foreign Agricultural Service; Ricardo Krajewski of the Agricultural Marketing Service; Peter Riley, Phil Sronce, and Jerry Norton of the Farm Service Agency; Chris de Brey of The Sulphur Institute; Steve Fuller of Texas A&M University; and Edward G. Schuh of the Hubert H. Humphrey Institute of Public Affairs for their timely reviews and helpful suggestions. Special thanks are extended to Dale Simms, for editorial assistance, and Wynnic Pointer-Napper for design assistance.

The authors would also like to extend special thanks to the many individuals in USDA's Foreign Agricultural Service, particularly Paul Provance and Rao Achutuni of FAS's Production Estimates and Crop Assessment Division, who provided invaluable data and crop intelligence information. We appreciate the various members of FAS's foreign service and host-country nationals working in the Attache missions in Argentina and Brazil, whose timely and informative reports were instrumental in providing an initial basis for understanding the agricultural sectors in those two countries.

Cover Photo: Soybean field in Mato Grosso by Rao Achutuni, FAS, USDA.

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## Foreword

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Since the mid-1990s, Argentina and Brazil have made enormous gains in agricultural output, particularly for soybeans. According to USDA data, their combined exports of soybeans and soybean products now exceed U.S. exports. But the data fail to tell the circumstances behind the production surge, and give no indication of its future potential. In the past, USDA's international focus has generally favored monitoring current and potential U.S. export markets, rather than export competitors. Distance and language have further encumbered the acquisition of information on agricultural developments in Argentina and Brazil.

The past several years have seen sensational media accounts of vast resource potential in Brazil. U.S. travelers to central Brazil report soybean fields that span the horizon, endless acres of inexpensive virgin soil, and boundless water resources.

This report attempts to demystify these claims and clarify the circumstances behind the agricultural boom in Argentina and Brazil. To this end, USDA's official data are supplemented by data from the U.N.'s Food and Agriculture Organization, the International Monetary Fund, the World Bank, and official data from various Argentine and Brazilian government ministries.

Based on a detailed description of the agricultural sectors and their underlying resource bases, this report also assesses the conditions likely to influence future agricultural growth in Argentina and Brazil. The intention is to lay a foundation and foster the further study of agricultural developments in Argentina and Brazil, particularly as they affect the U.S. farm sector and the government programs that support it.

## Executive Summary

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The United States has been the world's leading exporter of corn, soybeans, and wheat for the past 40 years, but Argentina and Brazil have made great inroads in recent years. Since 1990, Argentina and Brazil have sharply increased agricultural output and have gained global market share for several major commodities, particularly soybeans, often at the expense of the United States.

- ◆ *Since 1990, soybean production has more than doubled in Argentina and Brazil. Argentina's wheat and corn production is up 75 and 105 percent, and Brazil's corn production has increased by 40 percent. In contrast, soybean and corn production in the United States have expanded by about 42 and 25 percent during the same period, while wheat production has declined.*
- ◆ *Soybean production in Argentina and Brazil has expanded faster than domestic use, contributing to rising exports and growth in global market share. Combined soybean-and-product exports (in soybean equivalents) for the two countries is expected to account for nearly 50 percent of world trade in 2001, up from 40 percent during 1989-91, and easily surpassing the United States' 35-percent share. During the same period, Argentina's average shares of global corn and wheat trade have more than doubled to 13 and 10 percent, respectively. Even more striking is the dramatic reversal in Brazil's corn trade, switching from average net imports of almost 1 million tons per year during the 1990s to projected net exports of nearly 3.7 million tons in 2000/01.*

The dramatic growth in production and trade has caused policymakers and market participants to consider its origins, sustainability, and potential for future expansion. Increased South American supplies have no doubt contributed to the low international commodity prices of recent years, which have squeezed market returns to U.S. producers and prompted large government payments. South American field crop output will clearly have an ongoing influence on U.S. farm exports, prices, incomes, budgetary outlays, and program options.

This report presents research by the Economic Research Service (ERS) on the factors underlying the recent surge in agricultural production in Argentina and Brazil, and evaluates the prospects for future area and yield growth. Among its findings:

- ◆ *Economic and political reforms undertaken by Argentina and Brazil during the early and mid-1990s underpinned their surge in agricultural output. The reforms contributed to greater market orientation and a more stable macroeconomic environment for investment and decisionmaking. Previously, both countries had long histories of economic instability involving hyperinflation, overvalued exchange rates, and frequent currency realignments. The agricultural sectors of both countries were also subject to pervasive policy intervention that ultimately promoted other sectors at the expense of agriculture. Export taxes and quotas were used extensively to dampen internal prices and encourage domestic processing, while high tariffs and import controls on agricultural inputs promoted "import substitution" programs benefiting domestic industries.*
- ◆ *The economic and policy reforms and improved transportation and marketing infrastructures in Argentina and Brazil have lowered production and marketing costs and enhanced transmission of international market signals. With liberal-*

ized trade and strengthened market signals, imports and use of agricultural inputs and technology increased markedly throughout the 1990s. The improved investment climate and reduced border controls also ushered in foreign direct investment, which increased competitiveness and efficiency in the agricultural sectors of both countries.

- ◆ *Strong international commodity prices of the mid-1990s provided a powerful incentive to invest in agriculture and expand production.* A period of high crop prices shortly after the initiation of economic and policy reforms enabled Argentine and Brazilian farmers to take advantage of the increased market orientation.
- ◆ *Improved crop varieties and cultural practices suitable to the soils and tropical conditions of central Brazil helped large-scale mechanized agriculture expand into Brazil's vast, undeveloped interior regions.* Brazil's national research network—EMBRAPA—successfully adapted temperate-zone plant varieties (particularly soybeans) to the tropical conditions of its vast interior savannas, while retaining high-yield potential. Previously, the acidic soils and humid, tropical climate posed severe barriers to the development of commercial agriculture in Brazil's interior.
- ◆ *With their abundant land and good climate, Argentina and Brazil are naturally low-cost producers of soybeans and other crops.* Total farm-level costs per bushel of soybeans (in 1998/99) were 20 to 25 percent lower in Brazil and Argentina than in the United States. U.S. producers had the lowest variable costs of production, but this advantage was more than offset by higher land costs. Lower production costs have provided a strong competitive edge in international markets for Argentine and Brazilian soybeans, but this advantage is partially offset by higher transportation and marketing costs to export destinations.

ERS research into potential growth of Argentina's and Brazil's agricultural production suggests:

- ◆ *Brazil, and to a lesser extent Argentina, still enjoys tremendous potential to expand area devoted to agricultural production.* Brazil contains the world's largest remaining tract of virgin land—an estimated 547 million hectares remain as virgin scrub land or rainforest. As much as one-fourth of this land is *cerrado*—a savannalike flatland readily convertible to agricultural activity. In addition, both Argentina and Brazil have huge areas under permanent pasture—an estimated 142.5 and 185 million hectares, respectively—that support “grass-fed” cattle industries. Part of this pasture land could be converted to grain and oilseed production under the right market signals.
- ◆ *In Brazil, infrastructure development will remain critical to the pace at which land resources are brought into productive use.* Transportation costs in Brazil still represent a very large portion of the export price compared with the United States. Brazil's transportation infrastructure and port facilities are still deficient and costly, and will require substantial financial investment to support significant agricultural output growth. The average distance to ports from Brazil's Center-West is over 1,000 kilometers, and Brazil still relies predominantly on expensive overland truck transportation to move most bulk commodities. Several major projects are underway to connect the interior with major ports serving oceangoing vessels on the Amazon and on the east coast. Their completion will likely lower internal transportation and input costs and raise farmgate prices for Brazilian farmers.

- ◆ *The evolution of livestock-field crop tradeoffs is likely to drive developments in Argentina's agricultural sector.* Argentina is the world's leading per capita beef-consuming country, but the consumption rate has declined over the past 15 years. Nearly 90 percent of Argentina's beef production is entirely grass fed, but in the future, greater targeting of high-valued international meat markets (where "grain-finished" beef is preferred) could create incentives to free pasture for increased field crop production. However, the prevalence of foot-and-mouth disease (FMD) in South American animal populations continues to plague red meat exports.
- ◆ *Argentina and Brazil have significant potential to increase yields for several field crops, particularly corn.* Argentina's corn yields rose nearly 50 percent between 1990/91 and 2000/01, but are still only two-thirds of average U.S. yields. Gradually increasing fertilizer use helps explain much of Argentina's recent corn yield increases, and the strong presence of multinational corporations is promoting new agricultural technology there. In Brazil, cropland expansion in the Center-West is expected to raise national average yields. Crop yields for soybeans and cotton in the Center-West are already equivalent to average yields in the United States, and research is underway to improve corn and upland rice yields. Large farm sizes, the rapid adoption of new technologies, and innovative management practices have contributed to high yields in the Center-West, and helped to produce acceptable returns, even with low international commodity prices.
- ◆ *Brazil is projected to be the world's leading importer of wheat, starting in 2000/01 at 7.2 million tons and extending throughout USDA's baseline projection to 2010.* Brazil's wheat production has dropped since production subsidies and some import barriers were removed in the early 1990s. In contrast to soybeans, corn, and more recently cotton, Brazil's predominantly tropical setting has prevented the expansion of most small grain production beyond the southernmost States. Continued population and gross domestic product (GDP) growth are expected to bolster demand for wheat products well into the future.
- ◆ *An estimated 20 percent of Argentina's 2001 corn crop and 90 percent of its soybean crop were planted to biotech varieties, as producers have sought to capture the significant cost savings associated with biotech crops.* Given Argentina's adoption rates of biotech corn and soybean varieties, and a lack of sufficient storage capacity under the identity preservation (IP) system, the additional costs incurred in implementing an IP system would likely limit Argentina's potential to capture a market niche for nonbiotech corn or soybeans.
- ◆ *In Brazil, the Government currently prohibits commercial planting of genetically modified crops.* However, the strong incentive to benefit from the cost savings available to biotech soybeans likely contributes to significant illicit use of biotech seeds in Brazil's South. The share of biotech soybean plantings in the South has been estimated by various trade sources at between 20 to 40 percent. The situation is quite different in the isolated Center-West region, which can make a much stronger claim to biotech-free status for its soybeans.
- ◆ *Argentina and Brazil face several potential bottlenecks to growth.* These include large public and agricultural sector debt in both countries, poorly functioning domestic credit institutions, and high interest rates that limit the amount of credit available to all but large-scale agricultural producers.



# Agriculture in Brazil and Argentina

## Developments and Prospects for Major Field Crops

### Introduction

U.S. agriculture has historically benefited from its generous endowment of resources that include abundant, fertile soils, favorable climate, strategic inland waterways, and long coastlines with deepwater ports. This initial resource endowment has been supplemented by a well-developed rural transportation and marketing infrastructure, well-educated agricultural entrepreneurs who are quick to adopt new technologies, and a strong network of agricultural research, extension, and credit institutions. In addition, U.S. agriculture has benefited from private corporations that respond quickly to investment opportunities in agricultural production, processing, and marketing. This broad-based agricultural structure has permitted the United States to maintain a strong position among the world's leading producers and exporters of most temperate-zone field crops including soybeans, corn, cotton, wheat, sorghum, and rice.

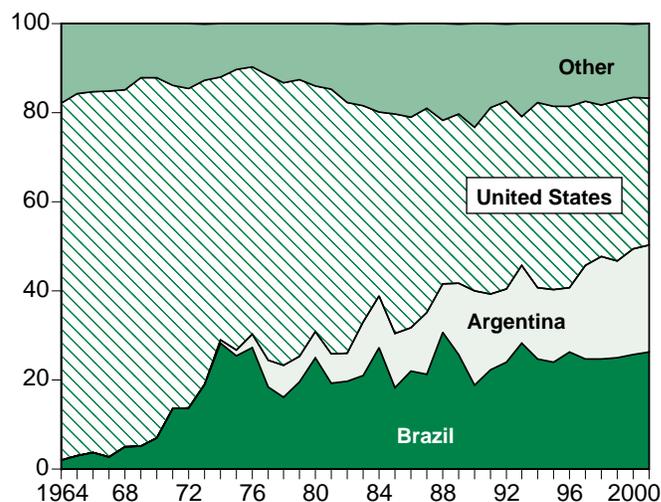
However, in the past decade two Southern Hemisphere competitors—Argentina and Brazil—have begun to tap more deeply into their own vast array of agricultural resources. Spurred by economic policy reforms, private investment (much of it from external sources) has been pouring into their agricultural sectors, applying cutting-edge technologies to historically underdeveloped production, marketing, and processing sectors. As a result, crop area and yields have been expanding rapidly, generating sharp increases in production. This output expansion, in turn, has translated into strong gains in global competitiveness in several commodity markets important to the United States, most notably soybeans and its products (fig. A-1).

In Brazil, soybean production doubled from an average of 18.5 million metric tons in 1989-91 to an estimated 41.5 million tons in 2001, while Argentina's production rose from 11.1 million tons to 27 million tons

Figure A-1

#### U.S. share of world soybean and soymeal market has steadily eroded\*

% of global exports



\*Soybeans and soymeal as soybean equivalents.

Source: USDA, August 10, 2001.

over the same period (table A-1). Soybean production in these two countries has expanded faster than domestic use, thereby contributing to rising exports and displacing U.S. export market share. From a global market share of over 80 percent during the 1960s, the U.S. share of soybean and product exports (in soybean equivalents) declined to only 39 percent in 1989-91 and about 35 percent in 1999-2001. The combined share for Brazil and Argentina has grown from less than 10 percent in the 1960s to nearly 50 percent today. The continued decline of the U.S. trade share since the mid-1990s is particularly remarkable since U.S. farmers planted record area to soybeans for four consecutive years starting in 1998.

**Table A-1—Average production, yields, net exports, and market share (selected commodities): Argentina, Brazil, and the United States**

	Production			Yields <sup>2</sup>			Trade <sup>1</sup>					
							U.S.		Argentina		Brazil	
	U.S.	Arg.	Brazil	U.S.	Arg.	Brazil	Qty <sup>3</sup>	Share <sup>4</sup>	Qty <sup>3</sup>	Share <sup>4</sup>	Qty <sup>3</sup>	Share <sup>4</sup>
----- mmt -----			----- mt/ha -----			mmt	Percent	mmt	Percent	mmt	Percent	
<b>Soybean<sup>1</sup></b>												
1969-71	31.2	0.0	2.4	1.83	1.28	1.22	16.3	78.7	0.0	0.0	1.8	8.7
1989-91	52.9	11.1	18.5	2.26	2.31	1.79	23.6	39.1	10.9	18.0	13.5	22.3
1999-2001 <sup>5</sup>	75.5	24.9	38.0	2.55	2.52	2.65	35.2	33.9	24.1	23.2	27.6	26.6
2001 <sup>5</sup>	79.1	27.0	41.5	2.64	2.52	2.68	35.1	32.1	26.2	24.0	30.5	27.9
<b>Corn</b>												
1969-71	122.7	8.4	14.4	5.15	2.21	1.40	16.1	48.7	4.8	14.7	1.0	2.9
1989-91	194.2	7.8	25.8	7.18	3.79	1.95	48.1	67.8	4.3	6.0	-0.7	--
1999-2001 <sup>5</sup>	244.1	16.1	36.2	8.52	5.61	2.76	49.9	59.8	11.1	13.2	1.0	2.2
2001 <sup>5</sup>	239.5	15.5	36.0	8.55	5.74	2.81	51.8	62.1	10.7	12.8	0.5	1.2
<b>Wheat</b>												
1969-71	40.0	5.9	1.6	2.14	1.33	0.88	17.6	31.4	1.6	2.9	-1.8	--
1989-91	61.2	10.3	4.0	2.39	1.98	1.37	31.6	27.3	5.8	4.9	-3.5	--
1999-2001 <sup>5</sup>	58.9	16.6	2.4	2.80	2.57	1.68	26.3	22.3	12.1	9.4	-7.1	--
2001 <sup>5</sup>	53.3	17.5	3.2	2.71	2.57	2.00	25.4	21.7	13.0	10.1	-6.5	--

<sup>1</sup>Soybean trade includes both soybeans and soymeal expressed in soybean equivalents. <sup>2</sup> mt/ha = metric tons per hectare.

<sup>3</sup> Qty = quantity traded where >0 are net exports and <0 are net imports; mmt = million metric tons. <sup>4</sup> Share = country-specific exports as a percent of world exports. <sup>5</sup> Year 2001 is marketing year 2001/02, estimated as of October 12, 2001, and may be subject to revision. For Brazil and Argentina, the 2001 crop is not harvested until early 2002.

Source: Economic Research Service, USDA.

Argentina's corn and wheat production and exports have also made significant gains since 1990 and have coincided with a decline in the U.S. share of these exports. Rebounding from a severe decline during the late 1980s, Argentina's corn production doubled from 1989-91 to 2001 and wheat production rose by 75 percent. In contrast, U.S. soybean and corn production each expanded by about 42 and 25 percent in the last decade, while wheat production has declined. Since 1990, Argentina's shares of global corn and wheat trade have nearly doubled, to 13 and 10 percent. Argentina is also among the world's leading exporters of sorghum, sunflower, and peanuts.

Brazil, traditionally a net importer of wheat, corn, cotton, and rice, has also been expanding its capacity to produce field crops other than soybeans. Brazil has been the world's third-leading corn producer for the past 40 years, but has averaged net imports of almost 1 million tons per year during the 1990s. However, with a record corn crop of 41 million tons in 2000/01—up nearly 60 percent since 1990—Brazil is projected to become a net exporter of about 3.7 million tons of corn in 2000/01. Brazil's corn export surge may be a

temporary phenomenon, but it would be the first time since 1981 that it has been a net corn exporter.

In contrast to soybeans, corn, and more recently cotton, Brazil's predominantly tropical setting has prevented the expansion of most small grain production beyond the southernmost States. Brazil's wheat industry has been in decline since production subsidies and import protection were removed in the early 1990s. Continued population and income growth have bolstered demand for wheat products, and Brazil was the world's leading wheat importer in 1999/2000 (7.6 million tons) and 2000/01 (7.2 million tons).

Despite great strides to date, Argentina and Brazil have yet to fully develop their agricultural resources. Until recently, trade policies in both countries suffocated their agricultural sectors by closing domestic markets to outside competition, technology, and investments, while imposing taxes on agricultural exports to finance other sectors of their economies. Both countries also suffered from government mismanagement that fostered hyperinflation, severe exchange rate overvaluation, high interest rates, endemic currency devaluations, and a generally poor investment climate. The net effect

of these policies was to hinder investment in the agricultural sector and in the transportation and marketing infrastructure needed to support agricultural growth.

Nevertheless, economic and political reforms of the early to mid-1990s have improved the investment climate, unleashing a reservoir of latent comparative advantage in each country's agricultural sector. While significant hurdles remain for Argentina and Brazil to fully realize their agricultural production potential, it remains substantial.

This report examines the factors underlying Argentina's and Brazil's surge in agricultural produc-

tion and trade during the 1990s—i.e., its origins and sustainability, as well as the prospects for further expansion. More specifically, it focuses on the relative competitiveness of Argentina, Brazil, and the United States in international soybean markets. The report also assesses the longrun production and trade outlook for both Argentina and Brazil.

Important informational needs remain, but this report is intended to provide a foundation for further study into the nature and potential consequences of continued agricultural development by Argentina and Brazil.

# A Comparison of Economic and Agricultural Settings

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## Introduction

Argentina, Brazil, and the United States have competed in international agricultural markets for decades. However, a very different set of demographic, geographic, and economic circumstances underlies each country's competitive position. This chapter provides some perspective to the differences and similarities that distinguish these three agricultural competitors. In addition, it sets the stage for a later discussion of agricultural development in Argentina and Brazil by comparing their population and economic characteristics, land base, the climate for each country's principal areas of agricultural production, and finally, the transportation and marketing infrastructure.

## Agriculture's Economic Role Differs Sharply

The U.S. economy is both huge (in terms of aggregate GDP) and wealthy (in terms of GDP per capita). But based on GDP per capita, life expectancy, and literacy criteria, Argentina has fast closed the gap with the United States, while Brazil still lags further behind.

In the United States, agriculture accounts for only 2 percent of GDP, 10 percent of total merchandise export value, and employs about 3 percent of the labor force (table B-1). Agriculture plays a significantly more important role in Brazil, where it represents 14 percent of GDP, 33.5 percent of the value of exports, and provides jobs for 31 percent of the labor force. Argentina's agricultural sector ranks midway between the United States and Brazil in terms of economic importance, representing 7 percent of its GDP and providing jobs for 12 percent of the labor force. However, Argentina depends heavily on agriculture for export earnings—52 percent of merchandise export value comes from agricultural products.

Brazil and the United States have large domestic markets that consume most of their agricultural output. For the United States, export markets are an important but residual destination for much of its cereal and oilseed (and products) output. In Brazil's case, international markets compete more directly with domestic markets as a source of demand. With a relatively small population, Argentina relies most directly on international markets as an outlet for its grain and oilseed production.

## Abundant Land Base Strikes a Common Theme

The combined total land area of 1.1 billion hectares for Argentina and Brazil is 22 percent larger than U.S. area. Yet they are almost identical to the United States in area devoted to agricultural activities—about 419 million hectares in 1998 (table B-2). However, only 78 million hectares were involved in field crop production in these two countries in 1998, compared with 177 million hectares in the United States.

The limited share of available area devoted to field crop production, particularly in Brazil, underscores the tremendous potential for expansion. Nearly 600 million hectares of land in the two countries are covered by agriculturally untouched forests and scrub land, foremost of which is Brazil's vast *cerrado* savanna in the Center-West, which represents the world's greatest remaining tract of accessible but relatively underdeveloped farmland. Warnken (1999) described the *cerrado*'s agricultural potential as follows:

*With millions of hectares of unopened virgin cerrado land, Brazil has the technical potential to increase national soybean area and production nearly tenfold. The technically viable expansion area for Brazilian soybeans is larger than the land area of all but twelve countries of the world, nearly 4 times 1995 U.S. soybean acreage (24.9 million*

**Table B-1—Argentina, Brazil, and the United States at a glance**

Category	Unit	Argentina	Brazil	United States
Population (2000) <sup>1</sup>	Million	37.0	172.9	275.6
Population growth rate <sup>*2</sup>	Percent/year	1.3	1.3	1.2
Life expectancy <sup>1</sup>	Years	75.1	62.9	77.1
Literacy rate <sup>1</sup>	Percent	96.2	83.3	97.0
Food consumption <sup>3</sup>	Calories/day	3,138	2,899	3,505
Meat consumption <sup>3</sup>	kgs/capita/year	100	74	124
GDP-PPP** (1999) <sup>1</sup>	Billion U.S. \$	367	1,057	9,255
GDP-PPP** per capita <sup>1</sup>	U.S. \$/capita	10,000	6,150	33,900
Agr. share of GDP-PPP** <sup>1</sup>	Percent	7	14	2
GDP-nominal (2000) <sup>4</sup>	Billion U.S. \$	284	665	9,963
Foreign debt <sup>4</sup>	Billion U.S. \$	150	251	7,536
Agricultural debt	Billion U.S. \$	7 <sup>5</sup>	13 <sup>5</sup>	181 <sup>6</sup>
Labor force (1997) <sup>1</sup>	Million	15	74	139
Agr. share of labor force <sup>1</sup>	Percent	12	31	3
Land area <sup>3</sup>	1,000 sq. km.	2,737	8,457	9,159
Percent in agriculture <sup>3</sup>	Percent	62	30	46
Total merchandise exports <sup>2</sup>	Billion U.S. \$	23.3	48.0	695.2
Agricultural exports <sup>2</sup>	Billion U.S. \$	12.1	16.1	69.6
Agr. share of exports <sup>2</sup>	Percent	51.9	33.5	10.0

Source: <sup>1</sup>CIA Fact Book, CIA, U.S. Government; <http://www.cia.gov/cia/publications/factbook/>.

<sup>2</sup>World Development Indicators, CD-ROM, World Bank; export data is 1999 f.o.b. exports of food and agricultural raw materials.

<sup>3</sup>FAOSTATS, FAO; <sup>4</sup>DRI-WEFA database; <sup>5</sup>FAS, USDA; <sup>6</sup>*Agricultural Income & Finance*, AIS-76, Feb. 2001, ERS, USDA.

\*1993-99 average. \*\*Purchasing power parity basis.

**Table B-2—Animal numbers and land use patterns: Argentina, Brazil, and the United States**

Category	Argentina		Brazil		United States	
	Mil. hectares	Percent	Mil. hectares	Percent	Mil. hectares	Percent
<b>Total land area (1998)</b>	<b>273.7</b>	<b>100</b>	<b>845.7</b>	<b>100</b>	<b>915.9</b>	<b>100</b>
Forest & scrub land	50.9	19	547.3	65	296.0	32
Mountains & other	53.6	20	48.2	6	201.7	22
Agriculture	169.2	62	250.2	30	418.3	46
Permanent pasture	142.0	52	185.0	22	239.3	26
Cropland	25.0	9	53.2	6	177.0	19
Permanent crops	2.2	1	12.0	1	2.1	0
	----- Million head -----					
<b>Livestock (2000)</b>						
Cattle stock	55.0		167.5		98.0	
Pigs stock	3.2		27.3		59.3	
Sheep stock	14.0		18.3		7.2	
	----- Million metric tons -----					
Poultry production	0.9		6.0		16.5	

Source: FAOSTATS, FAO.

hectares), and 160 percent larger than 1995 world soybean production area (61.3 million hectares).<sup>1</sup>

In Argentina, arid conditions may preclude any dramatic increase in the exploitation of its scrub lands, but both countries also have large areas devoted to permanent pasture (estimated at a combined 327 million hectares). Depending on improved plant genetics, water availability, cultivation practices, and livestock sector dynamics, pasture may someday be used to further expand Argentina's cropland base.

All three countries have large livestock sectors—Brazil has the largest commercial cattle herd in the world. However, the cattle industries in Argentina and Brazil are almost entirely “grass fed,” and depend on permanent pasture for maintenance. As a result, pasture has traditionally been an important component of crop rotations in Argentina and Brazil, and much of the permanent pasture in both countries lies within major field-crop producing regions. In contrast, cattle in the United States are fed primarily concentrated feed rations once they go to feedlots, and permanent pasture is primarily limited to highly marginal land not easily converted to crop production.

## **The United States and Argentina Have Temperate Climates; Brazil is More Tropical**

A region's agro-climatic setting encompasses the physical characteristics of its climate and natural resource endowment. Key characteristics include temperature, precipitation, sunlight, growing season, day length, latitude and seasonal variations, soil types, topography, and elevation. These features determine the agronomic feasibility of producing certain crops as well as their potential yields.

### *United States*

The United States lies entirely within a temperate zone, but agro-climatic variations result in important regional specialization. For example, the rich, deep soils of the U.S. *Corn Belt*—stretching from Ohio westward through Indiana, Illinois, Iowa, southern Minnesota, and northern Missouri to Nebraska—make it one of the world's most productive corn-and soybean-growing regions (fig. B-1). The warm, humid conditions of the

U.S. *Cotton Belt* stretch from the Carolinas westward across the southern U.S. through the Delta States and into northern Texas, while a *Hard Wheat Belt* encompasses the arid Northern and Southern Plains States. Soft wheat production is spread throughout the wetter environments of both the Corn and Cotton Belts and the Pacific Northwest.

Livestock activities in the United States are also determined, in large part, by a region's resources and climate: the most marginal lands serve as a base for cow-calf operations, while hog, poultry, and cattle feeding operations are determined by the interplay of feed availability, proximity to markets, land opportunity costs, and (more recently) animal waste management and environmental considerations. These same forces are at work in Argentina and Brazil, although pasture management plays a more important role in field crop rotations and cattle production than in the United States. Animal waste management and environmental concerns are not major production constraints in Argentina and Brazil.

### *Argentina*

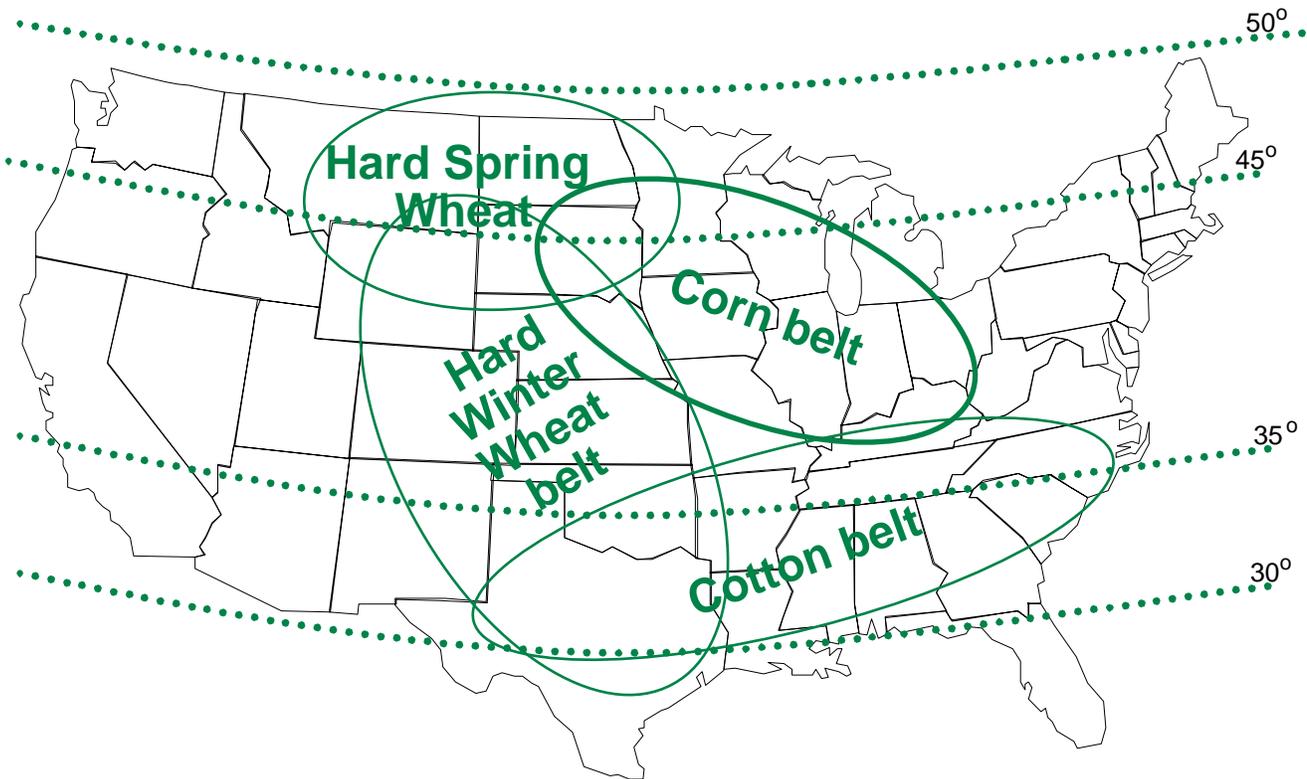
In Argentina, nearly all field crop production and most livestock activity occurs in the northeastern third of the country (fig. B-2). This is a humid, warm temperate zone similar in climate to the U.S. Southeast, but with more fertile soils. This rich agricultural zone is centered on the fertile *Pampas*—an area of slightly more than 50 million hectares—but extends into Argentina's northern tier of provinces that share a warmer, semitropical climate with the bordering regions of Bolivia, Paraguay, Brazil, and Uruguay (fig. B-3). It is bounded along the west by the Andes mountains, to the south by the rolling arid plateau of *Patagonia*, and to the north by the *Gran Chaco*—a region of hot temperatures, poor drainage, and thorn-infested scrub.

Argentina's primary agricultural region produces a variety of temperate crops, including most grains and oilseeds. Traditionally, most row-crop producers include some livestock operations as part of their activities. The central Provinces of Buenos Aires, Cordoba, Santa Fe, and western Entre Rios—located in the heart of the *Pampas*—dominate row-crop production. Over 90 percent of Argentina's soybean production takes place in these provinces. Between 80 to 90 percent of corn, wheat, sorghum, and barley production is also centered on these same Provinces, but extends farther south and west into the more arid Provinces of La Pampa and San Luis. The majority

<sup>1</sup>Warnken, Phillip F. *The Development and Growth of the Soybean Industry in Brazil*, Iowa State University Press, Ames, IA, 1999, p. 151.

Figure B-1

**The *Corn Belt* is the principal corn and soybean production zone in the United States**



Source: U.S. Department of Agriculture.

of sunflower production is also in the *Pampas*, but spreads into the Southwest and the warmer, wetter Provinces of the North. Argentina's rice production has traditionally been in the northeastern corner of the agricultural zone, while most cotton production is in the north-central States bordering the *Gran Chaco* scrubland.

Row-crop production has recently been developing in Argentina's northwestern provinces of Salta, Tucuman, and Santiago del Estero, spurred by the development of new varieties suited to their climates, improvements in the transportation infrastructure (via the river port of Resistencia on the Parana River), and improved access to export markets.

*Brazil's South*

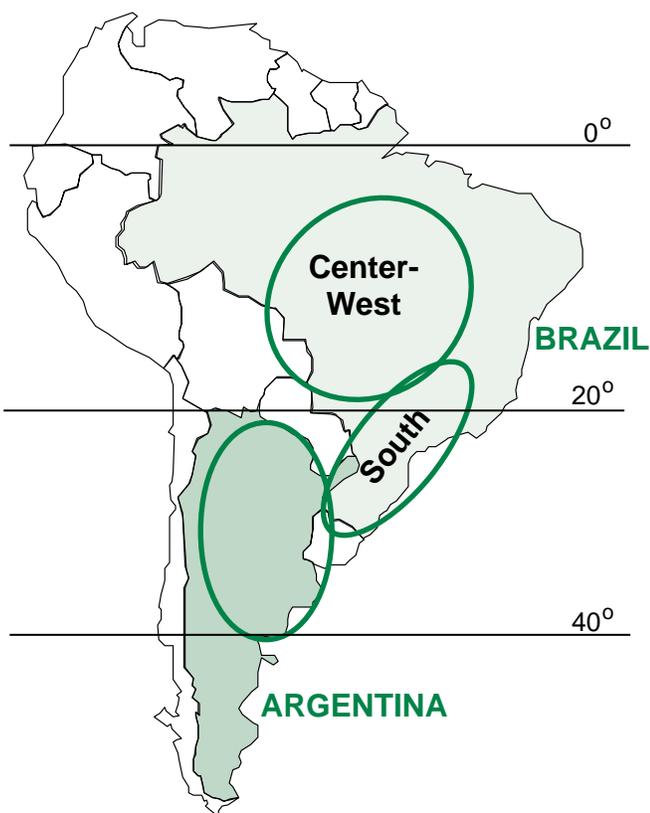
In Brazil, agricultural production is focused on two regions—the South and the Center-West. Brazil's South lies principally within the same humid, warm semitropical latitudes as the northern portions of Argentina's agricultural region. As a result, many of the livestock activities and field crop production—e.g., rice, corn, soybeans, and wheat—occur in both regions. Brazil's South has been among the world's

most productive agricultural zones for decades. For most of Brazil's history, field crop production was centered in this region's densely populated coastal states of Parana, Santa Catarina, and Rio Grande do Sul. Proximity to major urban centers, as well as the country's three major ports—Santos, Paranagua, and Rio Grande—give producers in this region easy access to markets. In addition, about half of Brazil's soybean crushing capacity is situated in the South.

In addition to row crops, several important food crops—i.e., legumes, pulses, tubers, and vegetables—compete with range land for the South's limited arable land. Parana's northern hillsides also produce an important share of the world's coffee. Rio Grande do Sul is home to most of Brazil's irrigated crop acreage and produces an important share of Brazil's rice. In recent decades, increasing population density in the South has parcelized family farms and reduced farm size. Smaller farm size and abundant labor have combined to inhibit economies of scale that ensue from larger farms, which can more readily adopt mechanization and other technological developments. This problem has contributed to the stagnation of field crop yields in the region.

Figure B-2

**Breakout of Argentina's and Brazil's main agricultural production zones**



Source: Economic Research Service, USDA.

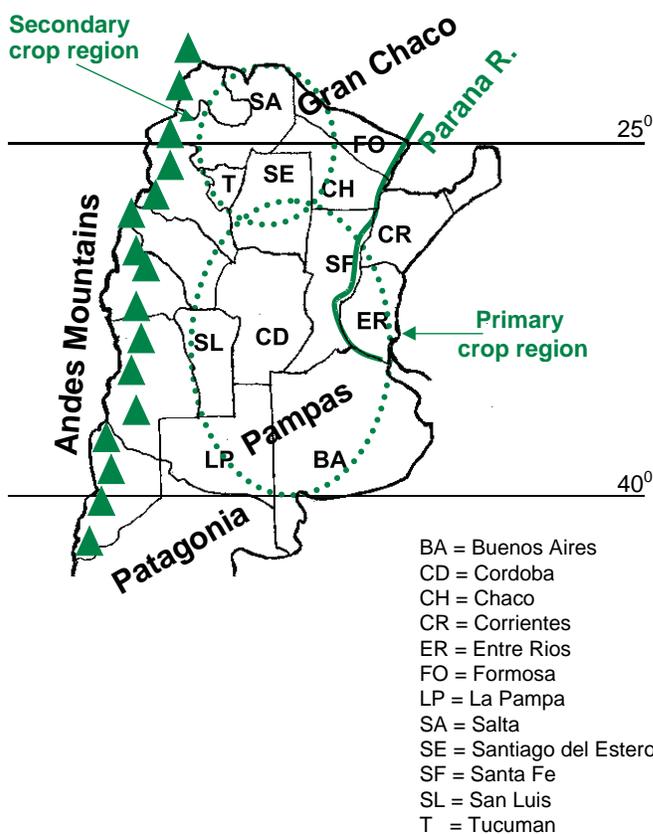
*Brazil's Center-West*

In the 1960s, under a variety of government incentives, agriculture began to expand into the *cerrado* lands of Brazil's interior States. Today, the Center-West rivals the South as the principal region of agricultural production within Brazil. The region lies entirely within South America's sprawling humid, tropical zone. As a result, Brazil has had to develop field crop varieties adapted to the lower variability of day length and temperature associated with tropical agriculture. Until recently, agricultural development in the interior region was also hindered by poor natural soil fertility and inaccessibility to the country's three major ports.

In accordance with Brazil's official regional designations, the Center-West sprawls across the tropical States of Mato Grosso, Mato Grosso do Sul, Goias, and the Federal District surrounding Brasilia. However, Rondonia, western Minas Gerais, and parts of the northeastern States of Bahia, Tocantins, Piaui, and Maranhao may be clumped into a more broadly defined "Center-West" since all of these States share

Figure B-3

**Argentina's major field crop regions**



Source: Economic Research Service, USDA.

the common feature of the Center-West's agriculture—development of the *cerrado* land, principally for soybean production (fig. B-4).

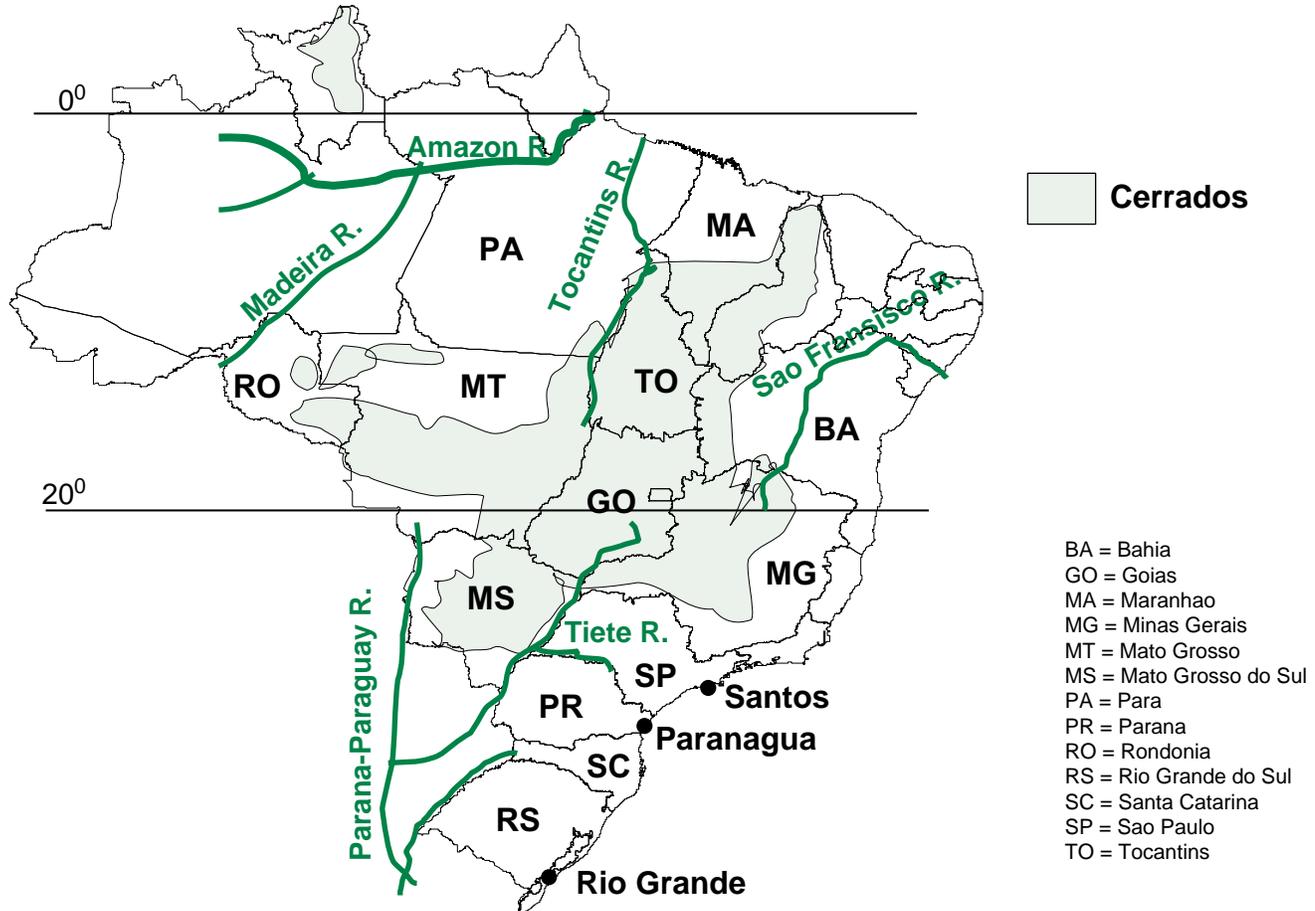
Today, most wheat production still takes place in the South. Corn production is more widespread. Double-cropping corn after early soybeans is fairly common in Parana and is rapidly expanding into the Center-West. Traditionally, most cotton production occurred in the South and Northeast, but in the past decade cotton production has been shifting rapidly to the Center-West. Soybean area is nearly evenly divided between the South and the Center-West.

**Hemisphere Location Results in Counterseasonal Crop Pattern and Supply Availability**

One of the most obvious and important differences between agricultural production in Argentina and Brazil compared with the United States is the nearly opposite seasonal timing of crop production. Latitudes

Figure B-4

**Brazil's *cerrado* sprawls across a wide band of central, northern, and eastern States**



Source: Adapted from Thorne and Thorne (1979), Warnken (1999), and the Dorling Kindersley *World Atlas* (2000).

in the Southern Hemisphere experience seasons with about a 6-month offset from northern latitudes. For example, the United States' primary spring-planted field crop growing period extends from April through September, compared with September-March in Argentina and Brazil's South (table B-3).

This counterseasonal pattern provides some advantage to Southern Hemisphere exporters of corn, soybeans, and wheat—all crops for which the United States has traditionally been the principal force in international price formation. U.S. and international prices generally reach their lows at U.S. harvest time (September-October) when supplies are most plentiful. Prices then gradually rise into the spring with carrying charges and accumulating demand. Argentine and Brazilian producers are able to benefit from this price recovery during February to April, their traditional growing and harvesting period.

**U.S. Growing Season Generally Shorter**

Corn and soybean production in the U.S. Corn Belt occurs at higher latitudes (35°- 48° North) than in Argentina (25°- 40° South) or Brazil's South (20°- 30° South) and tropical Center-West (0°- 20° South). As a result, the production zones of Argentina and Brazil all have significantly longer frost-free growing seasons.

The U.S. Corn Belt has a growing season of only about 4 ½ months in the northern portions and nearly 6 months in the southern extremities. In the Delta and South, the growing season extends for about 7 months, and the double-cropping of winter wheat with a spring crop (usually soybeans) is more common.

In contrast, Argentina's potential growing season extends a full 9 months from September through May.

**Table B-3—Principal field crop production stages for corn, soybeans, and wheat in Argentina, Brazil, and the United States**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
<b>Soybeans:</b>												
U.S.						[---Plant---	[Flower]	[---Fill---			[---Harvest---	
Argentina (1 <sup>st</sup> )		[Flower]	[Fill]	[---Harvest---							[---Plant---	
Argentina (2 <sup>nd</sup> )	[Plant]		[Flower]	[Fill]	[---Harvest---							
Brazil <sup>1</sup>	[Flower]	[Fill]	[-----Harvest-----]								[-----Plant-----]	
<b>Corn:</b>												
U.S.					[---Plant---		[-Silk-]		[---Harvest---			
Argentina	[Silk]	[Fill]	[-----Harvest-----]						[-----Plant-----]		[Silk]	
Brazil (1 <sup>st</sup> ) <sup>1</sup>	[---Silk---			[-----Harvest-----]							[-----Plant-----]	
Brazil (2 <sup>nd</sup> ) <sup>1</sup>						[---Plant---					[---Harvest---	
<b>Winter Wheat:</b>												
U.S.					[Head]	[---Harvest---			[-----Plant-----]			
Argentina					[-----Plant-----]			[---Head---		[---Harvest---		
Brazil <sup>1</sup>					[-----Plant-----]			[---Head---		[-----Harvest-----]		

<sup>1</sup>Because Brazil's agriculture covers such a vast agro-climatic setting, it is overly simplistic to assign a uniform seasonal pattern of production activity, but like Argentina, Brazil's seasonal crop production pattern generally runs countercyclical to that of the U.S.

Source: WAOB, USDA. *Major World Crop Areas and Climatic Profiles*, Agricultural Handbook No. 664; revised September 1994: Brazil's 2<sup>nd</sup> crop corn is from Hinrichsen.

Given Argentina's extended frost-free period and highly fertile soils, a preferred cropping strategy in terms of relative returns is double-cropping winter wheat with soybeans.

However, the opportunity to plant a second crop is limited to the central States of Buenos Aires, Cordoba, and Santa Fe due to the strong seasonal nature of precipitation. In addition, due to declining rainfall toward the end of the growing season, double-cropped soybean yields are generally much lower than first-crop soybeans. In Brazil's South, water is also the principal constraint to double-cropping. Brazil's Center-West lies entirely within the frost-free tropics and can technically produce three crops per year.

Apart from the longer frost-free period, Argentina's average growing-season temperature and precipitation levels nearly mirror the U.S. Corn Belt, except for the winter months (figs. B-5, B-6). During the growing season, average rainfall in Argentina's central Provinces ranges from 80 to 120 millimeters per month (about 3-5 inches), slightly higher than the U.S. Corn Belt, while the average temperature range at 20–24° Centigrade (68-75° Fahrenheit) is slightly milder. Argentina's rainfall and temperature distributions tend to increase in mean level and decrease in variability from the southwestern corner (La Pampa and San Luis where rainfall is least abundant and most variable)

toward the northern Provinces (where average precipitation and temperature levels are highest).

### **Brazil's Climate is Generally Milder and Wetter**

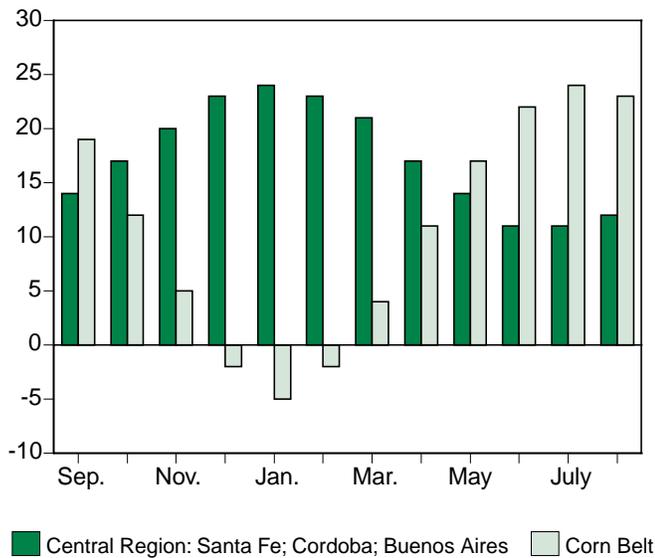
Compared with Argentina and the United States, Brazil's main agricultural production regions are generally milder and wetter. The South benefits from a moderating coastal influence, while the Center-West lies entirely within the frost-free tropics. As a result, monthly average temperatures exhibit very little seasonal variation throughout the year (fig. B-7). In Parana—one of the principal producer States in Brazil's South—average monthly temperatures have an annual range of only 17-24° C (63-75° F). In Mato Grosso—located in the heart of Brazil's Center-West region—the mean monthly temperature stays within the narrow band of 23-28° C (73-82° F).

Both the South and Center-West regions receive much more average precipitation during the growing season than either Argentina or the United States (fig. B-8). Monthly average growing-season precipitation ranges from 114 to 183 millimeters (4 ½ to 7 inches) in Parana, and 125 to 204 mm (5 to 8 in.) in Mato Grosso. However, Mato Grosso precipitation patterns are monsoonlike in that they drop to almost zero during the offseason months (June-August).

Figure B-5

**Growing season temperatures are very similar in the U.S. and Argentina, but with a 6-month offset**

Avg. monthly temp.: Centigrade

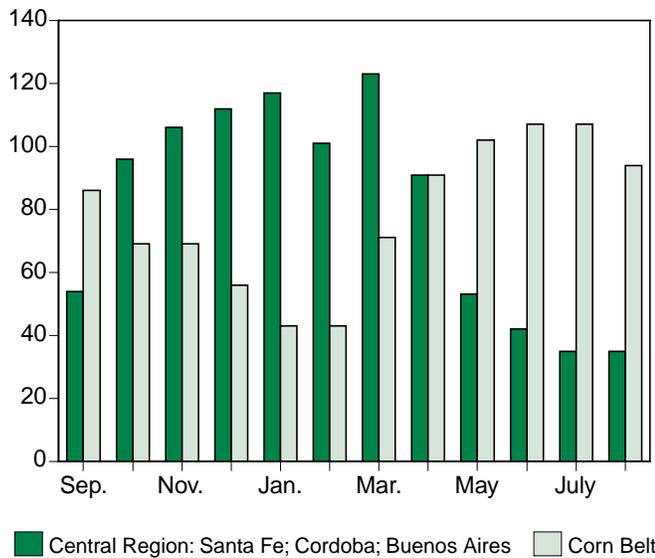


Source: Calculated using data from Joint Agricultural Weather Facility, USDA and NOAA.

Figure B-6

**Primary corn-soybean areas in the U.S. and Argentina receive comparable rainfall, but with a 6-month offset**

Avg. monthly rainfall: Millimeters

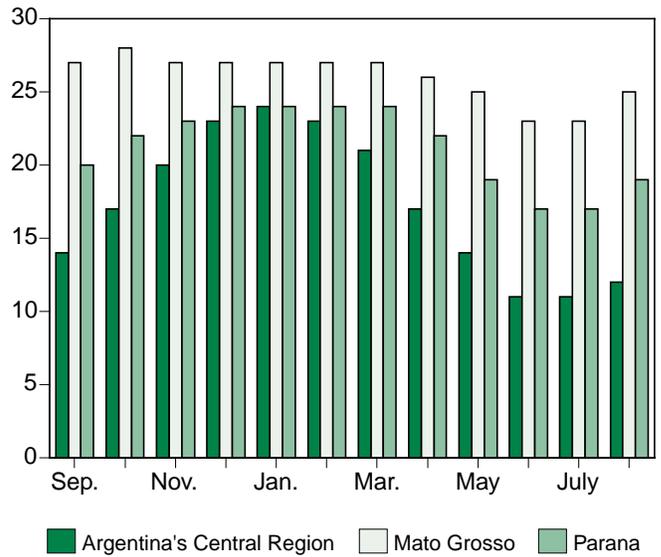


Source: Calculated using data from Joint Agricultural Weather Facility, USDA and NOAA.

Figure B-7

**Mato Grosso's tropical climate has very little seasonal variation in temperature**

Avg. monthly temp: Centigrade

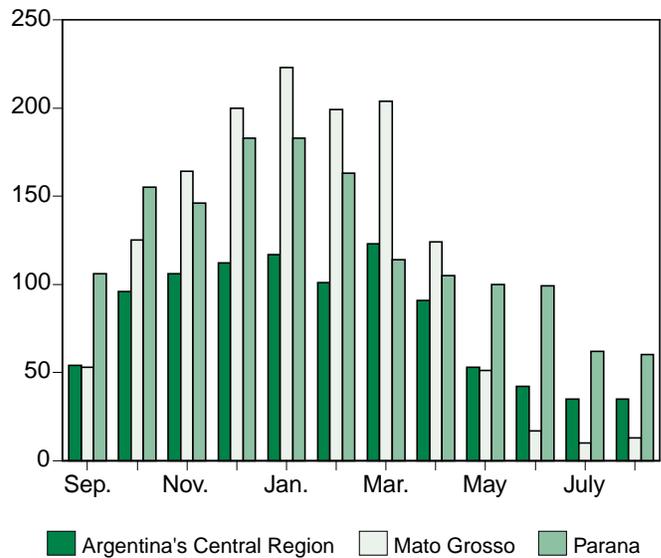


Source: Calculated using data from Joint Agricultural Weather Facility, USDA and NOAA.

Figure B-8

**Parana and Mato Grosso receive significantly more "growing season" rainfall than Argentina's primary agricultural zone**

Avg. monthly rainfall: Millimeters



Source: Calculated using data from Joint Agricultural Weather Facility, USDA and NOAA.

## Brazil's *Cerrado* Land Potential

The single most distinguishing feature between the South and the Center-West regions of Brazil is the latter's tremendous potential for continued growth of cultivated land area. In 1990, Brazil's national institute for agricultural research—EMBRAPA—estimated that 136 million hectares of the interior *cerrado* savanna were suitable for large-scale mechanized agriculture based on a rotation system of improved pasture, grains, and oilseeds (table C-4). At the time, 47 million hectares were already involved in production agriculture, leaving 89 million hectares of savanna land available for development as farmland.

In the past, poor natural soil fertility limited both the extent and range of agricultural development.

*Cerrado* soils, although deep and well-drained, are generally beset with acidity, aluminum toxicity, and deficiencies of phosphorus and nitrogen. The prevalence of clay soils, with their high phosphorus retention capacity, limits phosphorus availability to plant growth. Aluminum toxicity also inhibits crop rooting depth. When short-term droughts occur, the shallow-rooted crops are unable to draw moisture from the subsoil and are thus even more challenged than they normally would be.

However, soil management techniques have been developed to elevate these soils to among the world's most productive. **Liming** helps to neutralize soil acidity, adds calcium and magnesium, and reduces aluminum toxicity. As much as 5 tons of lime per hectare are needed to prepare *cerrado* soils for field crop cultivation. For high concentrations of clay,

**Table B-4—Cerrado area's agricultural potential: 1990 and projected use**

Agricultural activity	Estimated use (1990)	Projected use	Undeveloped
--- Million hectares ---			
<b>Cropland</b>	12	76	64
Irrigated	0	10	10
Dryland	10	60	50
Perennials	2	6	4
<b>Pasture</b>	35	60	25
<b>Total use</b>	47	136	89

Source: EMBRAPA as cited in Warnken (1999).

large initial amounts of **phosphorus** must be added to help promote plant growth. In addition, **crop-breeding** programs have successfully produced varieties that are more tolerant to high aluminum and low phosphorous levels in the soil.

Nevertheless, the economic feasibility of these solutions depends on the availability and cost of needed fertilizers and lime, and on a transportation infrastructure adequate to move agricultural inputs and market outputs to these inland producing areas. Most agricultural land of the interior States is far removed from markets, and the infrastructure is poorly developed. As a result, infrastructure development remains a primary determinant of the pace of agricultural expansion for Brazil's Center-West.

## Argentina and U.S. Soil Fertility Superior to Brazil's Center-West

The U.S. Corn Belt is famous for its deep, rich soils, but Argentina's *Pampas* soils are equally fertile and have produced bountiful grain and oilseed crops for decades with very low fertilizer use. However, most of Argentina's cereal yield gains of the 1990s have resulted from increased use of chemical inputs and improved seeds.

Like its precipitation pattern, soil fertility in Argentina's main agricultural region tends to increase in a northeasterly direction from the Rio Negro across

the northern half of Argentina and into Brazil's South. As a result, there is a west-to-east distribution of soils and climatic conditions that become progressively more favorable to intensive field crop production. Just to the east of the Andes Mountains, a wide band of generally dry soils runs the length of the country dividing Argentina down the middle and permitting only seasonal grazing at best. Moving eastward, increasing precipitation allows for grazing or crop-fallow rotations with drought-hardy small grains and oilseeds. Further eastward into Cordoba and Buenos Aires, highly fertile soils—mollisols similar to those found in the western U.S. Corn Belt—combine with more favorable moisture to promote intensive corn and soybean production.

Similar to Argentina's central region, highly fertile soils in Brazil's South allow for a wide range of intensive crop and livestock activities. However, soils in Brazil's Center-West are significantly inferior to soils found in the South or Argentina's *Pampas* region. The tropical soils—oxisols and ultisols—of Brazil's Center-West are naturally acidic, as well as highly oxidized and leached of many plant nutrients. Thus, they become rapidly depleted and infertile when placed under crop production.

However, the *cerrado's* soils possess several features attractive to agricultural production. They are generally deep and permeable with excellent water filtration and drainage, and proper soil management can elevate this naturally infertile soil to among the world's most productive. *Cerrado* soils are at a moderate elevation of 300-900 meters with only a slight grade, thus making them easily accessible to mechanization. Unlike the South, agriculture in the Center-West is characterized by much larger farms capable of adopting the full suite of modern production technology. Two-thirds of the *cerrado* is in farms that are larger than 1,000 hectares, compared with an average farm size of about 30 hectares in the South's principal soybean-producing State of Parana (and 120-150 hectares in the U.S. Corn Belt).

## **U.S. Infrastructure Vastly More Developed**

The transportation and marketing infrastructure for agricultural products in Argentina and Brazil has played a critical role in determining their international competitiveness. Both Argentina and Brazil possess long coastlines with major seaports providing outlets to international markets. Argentina has an important internal waterway, the Parana-Paraguay River system located close to the major grain-and-oilseed producing region. Brazil also possesses enormous internal waterway potential, including the world's largest river system—the Amazon River and its many tributaries. Development of the Amazon's tributaries is just beginning to open Brazil's interior agricultural areas to the ocean portal provided by the Amazon River.

Yet, despite considerably shorter average distances to ports from both Argentina's *Pampas* and Brazil's South, transportation and marketing costs for bulk agricultural product exports have historically been much higher for Argentina and Brazil than for the United States. This has generally reflected an ineffi-

cient or underdeveloped barge and railroad transportation system, and a heavy reliance on more expensive truck hauling. A Southern Hemisphere-Atlantic coast orientation and, in the past, export taxes and high port charges have also contributed to higher marketing and transportation costs to major international markets in Europe and East Asia.

In contrast, the United States has a widespread internal transportation network, centered on the Mississippi waterway and its many tributaries, to move bulk commodities to international markets cheaply and efficiently. The U.S. grain transport system relies heavily on barges that are unrivaled as the cheapest, most efficient mode for moving bulk commodities to export (table B-5).

Paved highways are more limited in Argentina and Brazil than in the United States, and even less prevalent in agricultural regions. Only 10 percent of Brazil's highways and 30 percent of Argentina's highways are paved, making transportation from farmgate to elevator or assembly point difficult, slow, and costly.

The availability of rail lines clearly favors the United States. The United States benefits further from a single standard gauge for its railways, in contrast with the cumbersome multiple gauges of Argentina and Brazil. Multiple gauges require costly transshipment stops when transporting across different-gauged tracks. U.S. railways also have substantially heavier railtrack than most rail lines in Argentina and Brazil. This allows for larger railcars and locomotives and higher load densities, which further reduce U.S. rail shipping costs.

Historically, Brazil and Argentina had underdeveloped storage systems, both on and off-farm, that forced output through the marketing channels at harvest time when local prices are usually at their lowest. In addition, insufficient storage capacity frequently forced open-air storage of in-transit grain and oilseeds. Such exposure to the elements and rodents often resulted in losses of both quality and quantity. The rush to bring harvested grains to the country elevator during harvest also generated significant delays, as trucks waited up to several days to unload their cargo. Limited storage capacity at elevators and river terminals has been cited as the single greatest bottleneck in Argentina's logistics systems (Goldsby, 2000).

However, policy changes initiated in the early 1990s—including the privatization and deregulation of railways and ports—have fostered a more favorable

**Table B-5—Infrastructure indicators for Argentina, Brazil, and the United States**

Item	Unit	Argentina	Brazil	United States
Infrastructure (2000) <sup>1</sup> :				
Total highways	1,000 km	215.4	1980.0	6331.0
Paved highways	1,000 km	63.6	184.1	3732.8
Total rail track	1,000 km	38.3*	27.9*	240.0
Navigable waterways	1,000 km	43.0	50.0	41.0
Average distance				
to export position	Kilometers	300	300 <sup>2,5</sup> - 1,500 <sup>2,6</sup>	1,400 <sup>7</sup>
Average cost (1998) <sup>3</sup>				
Barge	\$/mt/1,000 km	10	8 <sup>2,5</sup> - 13 <sup>2,6</sup>	5
Rail	\$/mt/1,000 km	50	25 <sup>2,5</sup> - 30 <sup>2,6</sup>	25
Truck	\$/mt/1,000 km	60	33 <sup>2,5</sup> - 50 <sup>2,6</sup>	45
Average share of exported grain and oilseed by mode (1998) <sup>3</sup>				
Barge	Percent	n.a.	n.a.	61
Rail	Percent	n.a.	n.a.	23
Truck	Percent	82	40 <sup>2,5</sup> - 80 <sup>2,6</sup>	16
Weighted average transport cost per 1,000 km (1998) <sup>2</sup>				
	\$/mt/1,000 km	63	26 <sup>2,5</sup> - 43 <sup>2,6</sup>	16
Weighted average transport cost to export position <sup>2</sup>				
	\$/mt	25	8 <sup>2,5</sup> - 65 <sup>2,6</sup>	16
Average port charges (1998) <sup>3</sup>				
	\$/mt	3-5	9-12	3
Grain storage capacity <sup>4</sup>				
	Million tons	49	n.a.	534.9 <sup>8</sup>

\*Multiple gauges. n.a. = not available; mt = metric ton. <sup>1</sup> CIA Fact Book, CIA, U.S. Government; <http://www.cia.gov/cia/publications/factbook/>.

<sup>2</sup> Authors' approximations. <sup>3</sup> Verheijden and Reca, 1998. <sup>4</sup> Goldsby, 1999. <sup>5</sup> South. <sup>6</sup> Center-West. <sup>7</sup> Approximate distance Chicago to Gulf Ports.

<sup>8</sup> Onfarm = 307.8 million tons; off-farm = 227.1 million tons (NASS, Dec. 1, 2000).

climate for infrastructure development. During the past decade, Argentina and Brazil have cut transportation and marketing costs considerably, narrowing the transport-cost gap with the United States (see chapter 5). In addition, significant investment in Argentina's storage capacity has removed much of the need for harvest-time sales. Argentina's total grain storage capacity in 1998 was estimated at 49 million tons, compared with 30 million tons in 1984 (Agriculture and Agri-Food Canada, 1999). The combined average production for corn, soybeans, and wheat during 1999-2001 was 57.6 million tons. However, other factors

such as congestion at specific ports, the timing of shipments, prolonged demurrage periods, and low onfarm storage capacity (only 27 percent of total capacity) continue to add to marketing costs.

Both countries (but particularly Brazil) still have further cost-reduction potential vis-à-vis improvements in their transportation and marketing infrastructure. If realized, such cost savings would further raise producer returns and heighten incentives to expand production. Recent infrastructure developments are discussed in chapters 3 and 4.

# Soybeans, Agriculture, and Policy in Argentina

## Introduction

Agriculture in Argentina encompasses nearly the entire range of field crop and livestock activities found in the United States, including corn, wheat, sorghum, sunflower, barley, oats, peanuts, rice, and cotton. But most notably, Argentina is the world's leading exporter of soybean products—soybean meal and soybean oil—and ranks third behind the United States and Brazil as a producer and exporter of soybeans.

Historically, the agricultural sector in Argentina has received very little direct government support. Consequently, relative returns across competing field crops, rotational considerations, and long-run investment plans have determined the evolution of cropping patterns. However, decisionmaking in the export-oriented agricultural sector was also influenced by the often negative effects of an unstable macroeconomic environment, trade restrictions on agricultural inputs and outputs, and government policies favoring industrial development and cheap domestic food prices, particularly for wheat and beef. Prior to economic and policy reforms of the early 1990s, these policies muted price transmission from global commodity markets and discouraged investment in the sector.

In 1990, Argentina enacted important economic reforms that began to stabilize the economy and create a more liberal policy regime favorable to agricultural investment, production, and exports. The success of these reforms has unleashed Argentina's natural comparative advantage in the production of major field crops, including soybeans, corn, wheat, and sunflower.

This chapter describes the evolution of Argentina's soybean sector, with a focus on the macroeconomic and agricultural policies that conditioned behavior in Argentina's agricultural sector. Then, relevant transportation and marketing infrastructure issues are presented. Finally, developments in other field crop

and livestock sectors, all of which compete for the same pool of agricultural resources, are discussed

## Argentina's Soybean Sector Starts Late, But Grows Rapidly

By the 1950s and 1960s, Argentina was already a major corn and wheat producer. In contrast, Argentina's soybean sector did not emerge until the early 1970s, lagging Brazil by more than a decade. In 1970, only 36,000 hectares of soybeans were harvested in Argentina, compared with 1.7 million hectares in Brazil and over 17 million in the United States (fig. C-1). Differences in soybean yields between South American and North American producers were equally wide. The 3-year average yield of 1.8 metric tons per hectare in the United States in 1969-71 was nearly 50 percent higher than yields in Argentina and Brazil.

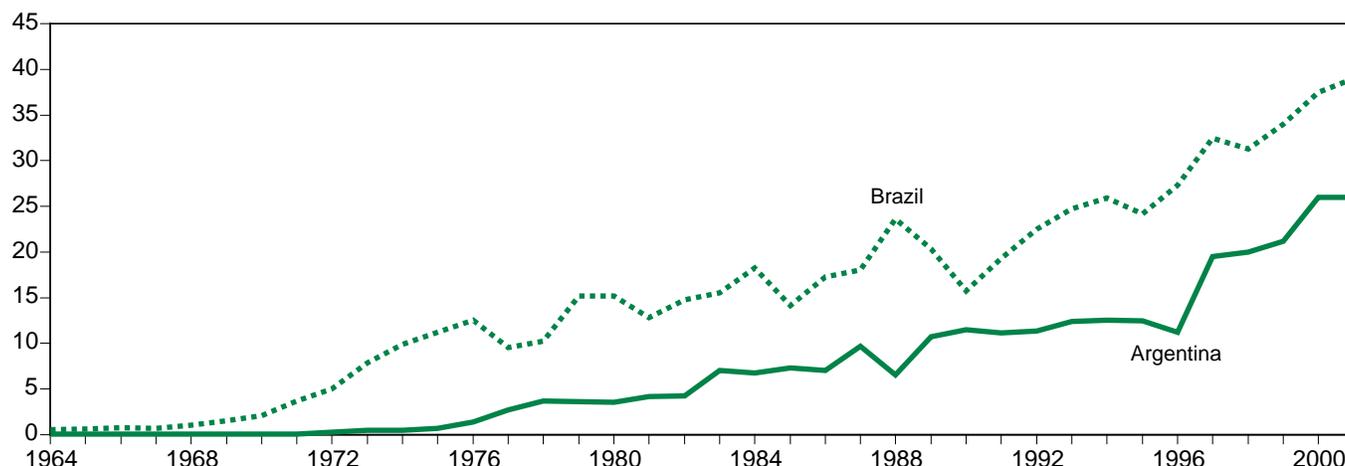
Record high international soybean prices in the early 1970s—prompted in part by a sharp drop in world fishmeal production, rapid growth in EU soybean consumption, and the U.S. oilseed export embargo of 1973—created strong incentives for Argentina's soybean producers, and their plantings grew tenfold between 1970 and 1974. Once soybean production gained a foothold, a strong natural comparative advantage over cereal production continued to boost plantings in Argentina. Throughout the 1970s, the profitability of oilseeds relative to coarse grains continued to entice area into soybeans and sunflowers and away from corn, sorghum, and barley. By 1979, soybean planted hectares surpassed 2 million, while corn plantings fell to 2.5 million hectares from a high of 4.1 million in 1970.

Cereal prices recovered somewhat in the early 1980s, temporarily slowing soybeans' rapid growth, but by the mid-1980s, soybeans were again posting year-over-year record plantings, and exceeded 5 million hectares by 1989 (fig. C-2).

Figure C-1

**The emergence of soybean production in Argentina during the 1970s followed Brazil by about a decade**

Mil. metric tons

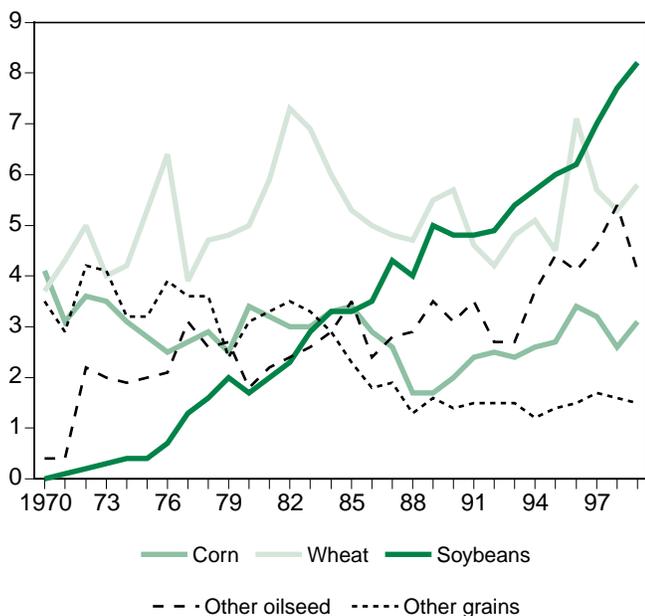


Source: USDA; August 10, 2001.

Figure C-2

**Argentina's soybean planted area has grown strongly compared with that of other field crops since the mid-1970s**

Mil. hectares planted



Source: SAGPyA, January 2001.

***Unstable Economy, Hostile Policy Setting Prior to Reforms***

Soybeans' rapid rise in Argentina is all the more remarkable because, for much of the postwar period, Argentina's agricultural sector was handicapped by an

unstable macroeconomic environment characterized by high inflation, an often overvalued exchange rate, and a heavy external debt burden. During the 1960s, 1970s, and 1980s, Argentina undertook a series of seven government programs designed to stabilize the chronic inflation but that instead undermined the nation's economy. These government programs were ineffective and resulted in extended periods of economic instability marked by chronic public sector deficits, low savings and investment, an unstable exchange rate, and highly variable inflation. During the 1960s the annual inflation rate hovered around 30 percent. However, by the mid-1980s and early 1990s, it had skyrocketed to annual rates in excess of 1,000 percent (fig. C-3).

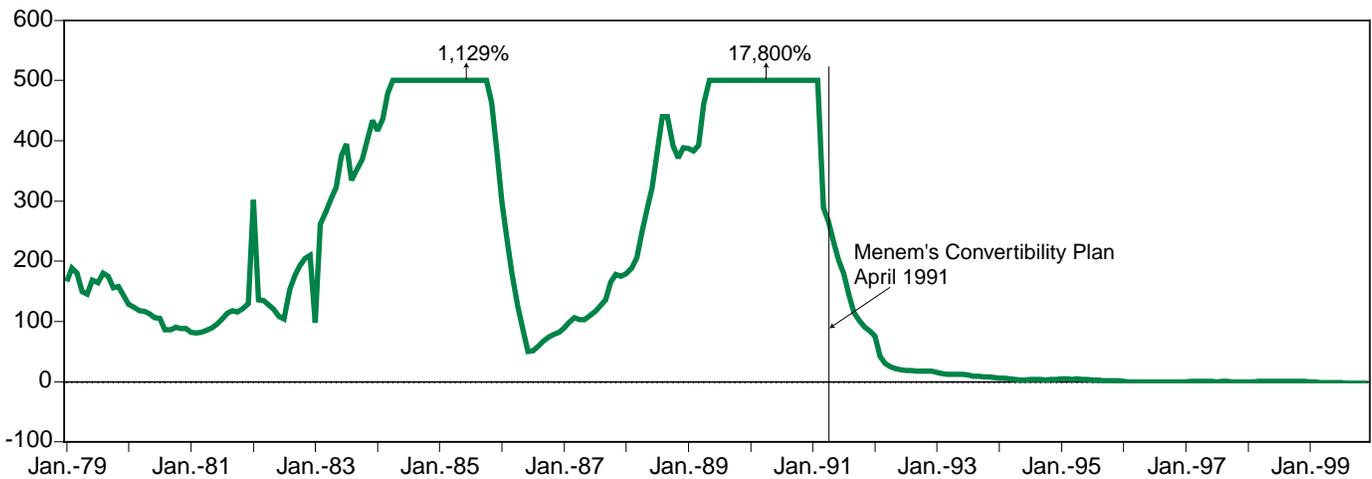
In addition to an unstable macroeconomic environment, the Government of Argentina (GOA) adopted in the early 1950s an import substitution strategy designed to promote economic growth and limit foreign debt and use of foreign exchange. Import substitution programs penalize the agricultural sector by forcing producers to rely on inefficient, overpriced domestic input industries and by limiting access to international agricultural markets.

Three principal policy instruments were used to support the import substitution strategy. First, tariffs and quantitative restrictions were applied on imported agricultural inputs to encourage the sale of domestically produced inputs. Prior to 1977, import tariffs on fertilizers and agricultural chemicals were 60 and 65 percent.

Figure C-3

**Argentina has suffered from bouts of severe hyperinflation\***

Rate of inflation (%)



\*Monthly observed annual inflation rate based on CPI data. Scale capped at 500 percent to facilitate presentation.

Source: IFS/IMF.

Second, export taxes on grain and oilseeds were introduced in 1982 to help pay for the budget expenditures incurred during the Malvinas-Falklands War. The export taxes were initially set at 18 percent but varied annually. Eventually, the taxes were expanded to most agricultural and agro-industrial products to ensure abundant, cheap supplies for domestic industries.

Finally, the GOA frequently manipulated exchange rate regimes in the belief that a fixed exchange rate would dampen domestic inflation. However, these efforts generally failed to curb inflation and often created other distortions such as high interest rates, real exchange rate appreciation, and an overvalued currency periodically corrected with currency devaluations. Argentina's currency overvaluation, when measured in terms of its purchasing power parity vis-à-vis foreign exchange rates, exceeded 100 percent throughout most of the 1980s and into the 1990s (fig. C-4). Since domestic producers are paid in domestic currency units, an overvalued currency burdens the agricultural sector by reducing the demand for and lowering the farm value of exported products.

The transfer produced by the GOA's exchange rate regimes often varied inversely with those produced by export taxes—i.e., when the exchange rate favored the agricultural sector, export taxes were raised and vice versa (fig. C-5). Nevertheless, an examination of Argentina's producer subsidy equivalents (PSEs)—a measure of net government domestic support to the

agricultural sector of the economy—during 1985-93 reveals that the overall policy regime was a net drag on the agricultural sector (Roberts, 1994).

By the late 1980s, a growing list of economic ills was compounded by a slump in international commodity prices, global recession, and the full explosion of the world debt crisis. By the end of the decade, Argentina's economy was plagued by huge external debts and hyperinflation. Argentina's foreign debt reached \$60 billion in 1986, representing 39 percent of the national GDP. Interest on this debt was equivalent to 50 percent of total export earnings. At this time, taxes on agricultural exports were generating 20 percent of central government revenues, and by 1988, export taxes and currency controls represented over 50 percent of the value of agricultural export prices at Argentine ports.

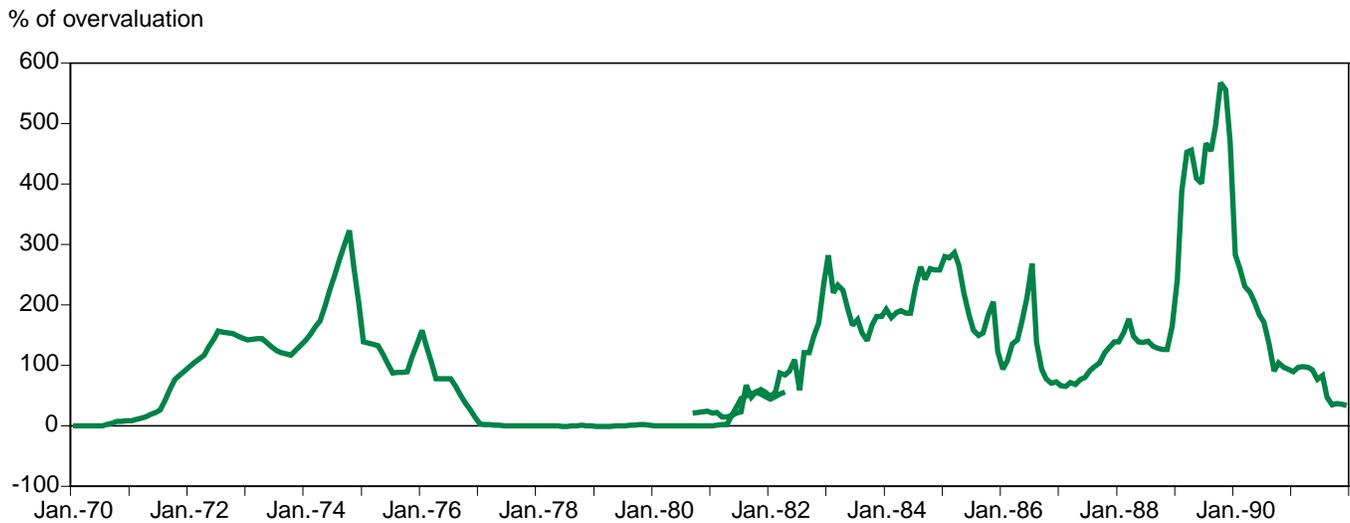
In addition, export taxes on agricultural products and import tariffs on agricultural inputs continued to distort production incentives and strangle agricultural productivity growth. Despite these obstacles, Argentina's agricultural output generally contributed to nearly half of export earnings and about 8-10 percent of GDP.

***Yield and Area Growth Drive Pre-Reform Soybean Sector***

Between 1970 and 1990, yield gains played a large role in Argentina's dramatic rise in soybean output. During this period, Argentina's soybean yields grew a steady 3

Figure C-4

**Argentina's exchange rate was routinely overvalued during the 1970s and 1980s\***

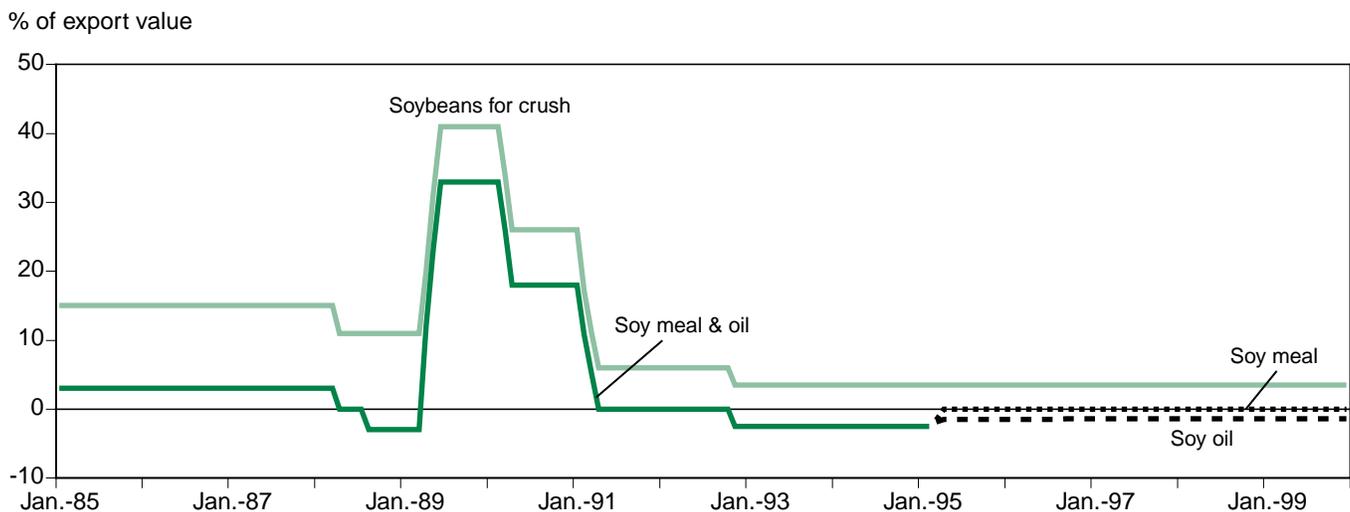


\*1970-1983: Official exchange as percent of "Free Market" rate; World Bank. 1981-1991: Rate of change in official exchange rate minus rate of change in a purchase power parity index comparing Argentina and U.S.; 11-month moving average of both series used to smooth data.

Source: World Bank; IFS/IMF; authors' calculations.

Figure C-5

**Prior to 1991, Argentina applied high export taxes on soybeans and products**



\*Negative taxes represent a rebate on export sales.

Source: Cámara de la Industria Aceitera de la Republica Argentina (CIARA).

percent annually, reflecting significant gains in productivity. As resources and know-how accumulated, Argentina's soybean yield quickly approached that of the United States and even exceeded U.S. yields a number of times during the 1970s and 1980s (fig. C-6). This yield growth, in the face of relatively low input

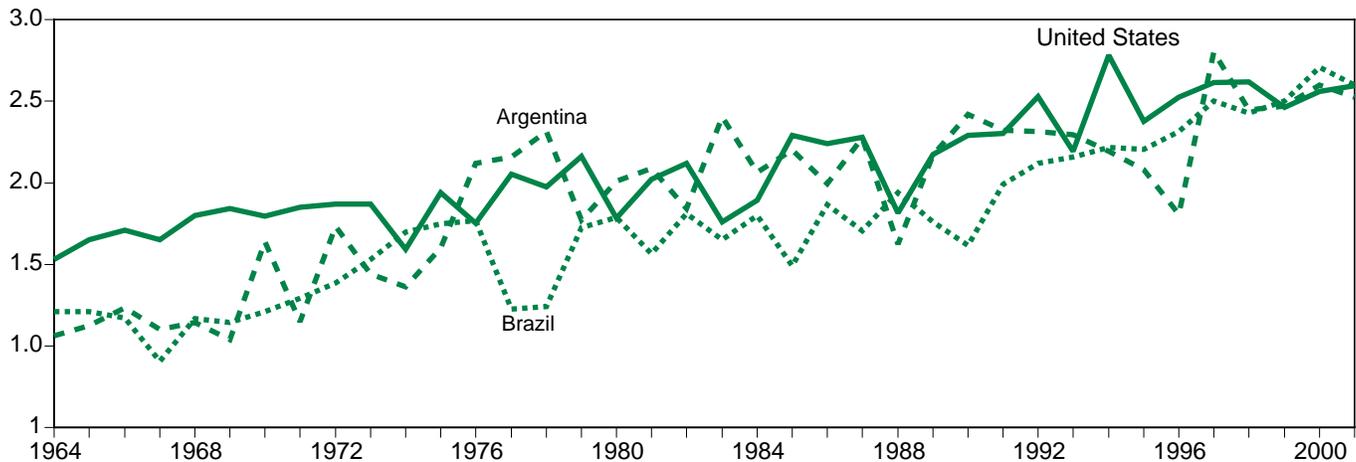
use, reflects Argentina's agro-climatic advantage in soybean production.

By 1989, 5 million hectares were planted to soybeans and production reached nearly 11 million tons. This expansion involved both new land entering soybean production as well as a shift of existing farmland from

Figure C-6

**Soybean yields in Argentina, Brazil, and the U.S. have been near parity since 1999**

Metric tons per hectare



Source: USDA; August 10, 2001.

coarse grains and pasture. In addition, harvested field crop area was bolstered by a declining rate of row-crop abandonment.

By the early 1990s, Argentina had become the world’s leading exporter of soyoil and a major soymeal exporter, garnering 30- and 22-percent market shares of world trade. Argentina’s soyoil exports accounted for 13.4 percent of the world market, temporarily surpassing Brazil as the second leading exporter of soybeans in 1990. Although Argentina produces less than Brazil, it has a much stronger export orientation due to limited domestic use. Argentina’s population is small and stable, the poultry and pork industries are relatively small, and the cattle industry is predominantly grass-fed. Only about 3 percent of Argentina’s soymeal and 6 percent of soyoil production were consumed domestically in the early 1990s, compared with Brazil’s 30 percent (soymeal) and 75 percent (soyoil). At the same time, domestic consumption accounted for about three-quarters of U.S. soymeal and nearly 90 percent of U.S. soyoil production. Consequently, increased production allowed Argentina to capture a significant share of the growing global soybean and product market.

**Menem Government Initiates Substantial Reforms in 1991**

In April 1991, the newly elected Menem government instituted a major currency realignment, the *Convertibility Plan*, followed by a series of dramatic market-

oriented policy changes, including privatization and deregulation measures that eliminated institutions and policies that had shifted resources from agriculture to other sectors for decades. These reforms reduced or rescinded both export taxes on agricultural commodities and tariffs on imported inputs. Some of the more salient changes for agriculture included the following:

- ◆ The elimination of all export taxes on major grain and processed oilseed products in 1991, except for the 3.5-percent tax on unprocessed oilseed exports.
- ◆ The elimination of all quantitative restrictions on imported agricultural inputs.
- ◆ The reduction of tariffs on imported agricultural inputs to a range not to exceed 15 percent of CIF (cost, insurance, and freight) value, although an additional 10-percent tax was levied on most imported agricultural inputs.
- ◆ The exemption from tariffs and taxes of agricultural inputs classified as capital goods—i.e., those whose economic life extends beyond one production cycle—such as embryos, certified seed, and trucks.
- ◆ The elimination of several government commodity agencies that held export monopolies for their respective commodities (e.g., the National Grain Board, the National Meat Board, and similar agencies for sugar and tobacco).
- ◆ The initiation of privatization in the marketing and transportation infrastructure, including state-owned grain elevators, port facilities, and railroads.

These and subsequent economic policy reforms have greatly improved the general climate for investment and growth in Argentina, and greater participation in global commodity markets has expanded access to technological innovations and agricultural inputs. Extensive privatization of the domestic marketing system combined with trade liberalization has allowed for a fuller transmission of international commodity prices and improved domestic producer incentives— incentives that were further reinforced by a period of high international market prices in the mid-1990s (see box, “High International Commodity Prices in 1996 Boosted Producer Incentives”).

Key to the *Convertibility Plan* was the establishment of a currency board and the passage by the Argentine Congress of the *Convertibility Law* designed to address the country’s currency woes. The Law of Convertibility made the peso fully convertible at a fixed nominal exchange rate of 10,000 australes to the U.S. dollar—i.e., 1 peso per U.S. \$1—and guaranteed access to dollars to anyone at any time at this rate. This law limited the GOA’s ability to finance expenditures by printing money that was not backed by dollar-denominated assets. This reform helped to arrest the hyperinflation problem immediately (Eiras and Schaefer, 2001).

By the end of 1992, the privatization of state-owned grain elevators was nearly complete. By 1993, the average import tariff had been reduced to 14 percent. The elimination of most export taxes reduced the transfers produced by the policy from 85 percent of the value of wheat, corn, sorghum, and soybean production in 1989 to 11 percent in 1992.

One of the GOA’s major short-term objectives was to encourage exports by reducing domestic costs of production. In November 1992, the GOA established an export rebate system, designed to offset the cost-increasing effects of internal value-added taxes on inputs. The export rebate for corn, wheat, sorghum, and oilseed products was set at 2.5 percent of F.O.B. price, Buenos Aires. In March 1995, the rebates on soymeal and soyoil were lowered to 1.6 and 1.9 percent. (There is no rebate for unprocessed oilseeds.) A month later, the soymeal rebate was eliminated, and the soyoil rebate was lowered to 1.5 percent. Since 1996, the soyoil rebate has been set at 1.4 percent.

The policy reforms, together with strong commodity prices in the mid-1990s, conferred more stability to

Argentina’s economy, and transformed the way the country produces and markets agricultural commodities. Argentina’s economy appeared to be on the mend. By 1993, Argentina’s external debt had dropped to \$60 billion after temporarily peaking at \$65 billion in 1992. In 1994-95, Argentina’s economy weathered a severe recession, but maintained its reform-oriented agenda.

On January 1, 1995, Argentina’s reform period was capped by the almost total elimination of trade restrictions within the MERCOSUR regional customs union encompassing Argentina, Brazil, Uruguay, and Paraguay. Although they now engage in trade with few internal duties, MERCOSUR members established a set of common external tariffs that can be very protectionist, as with U.S. corn exports to Brazil. Under the MERCOSUR agreement, Brazil has become Argentina’s largest market for many commodities, including wheat, rice, and cotton.

### ***Agricultural Input Use Rises Under Reform***

Following the opening of Argentina’s economy in the early 1990s, imports and use of agricultural inputs have increased dramatically. Farmers have invested heavily in new technologies that improve yields, accelerate planting and harvesting, and facilitate delivery to the elevator. Historically, high natural soil fertility and other factors (e.g., limited agricultural credit, low domestic production of inputs, and strict border controls on imports) limited fertilizer, pesticide, and machinery use.

In the early 1990s, Argentina’s fertilizer, pesticide, and agricultural machinery use, as well as plant genetics and seed development, lagged well behind the United States, partially explaining lower corn and wheat yields. In 1990, Argentina’s national average application rate for all fertilizers was 8 kilograms per hectare of combined field and permanent crop area, compared with 55 kg in Brazil and nearly 187 kg in the United States. By 1998, Argentina’s fertilizer use had more than tripled to 32 kg per hectare (compared with 196 kg/hectare in the United States), abetted by access to international supplies and favorable prices.

Total fertilizer imports (nitrogen, phosphate, and potash) by Argentina expanded from an average of 126,000 tons in 1989-91 to a record 945,000 tons by 1996. Total pesticide imports also rose sharply from an average value of \$69 million in 1989-91 to almost \$315 million in 1997. Imports of agricultural tractors,

## High International Commodity Prices in 1996 Boosted Producer Incentives

In May 1996, international prices (U.S. Gulf ports) hit record highs for several major field crops: wheat (hard red winter) at \$262 per ton, corn at \$204, sorghum at \$191. A year later, soybeans reached \$328 per ton, their highest price in 9 years (fig. C-7).

The price runup had its genesis in the early 1990s when, in the face of sagging production, world grain stocks were drawn down for 4 consecutive years (1992 through 1995) to meet growing demand driven by global economic growth. As a result, global stocks of wheat and coarse grains carried into 1996/97 fell to their lowest levels since the mid-1970s. The ratio of global ending stocks to use for wheat and coarse grains fell to only 15 percent in 1995/96, the lowest in the USDA database (PS&D) dating back to 1960. This left the world particularly vulnerable to major crop shortfalls or demand shocks, and generated substantial short-term price volatility.

A number of factors contributed to the tight grain supplies. Global grain production between 1993 and 1995 remained lower than its 1992 peak, with some of the major grain exporters experiencing below-normal crops. In late 1994, China, previously the world's second-largest exporter, halted corn exports. This move increased the world's dependence on U.S.

corn for feeding. But the 1995 U.S. corn crop was relatively small due to implementation of a 7.5-percent area set-aside (via the Acreage Reduction Program or ARP) on plantings and adverse weather.

Underlying these developments was a longer term decline in grain stocks, particularly in the United States. The reduction of government stocks had become a U.S. farm policy objective in the mid-1980's because stocks had grown to burdensome levels, reaching as high as 70 percent of annual use. The severe drought of 1988 further hastened the stock drawdown. By 1995, the price-depressing grain export subsidies of the early 1990s had dried up, and the European Union (EU) actually imposed an export tax in mid-1995 to discourage exports of wheat and try to shield internal users from spiraling prices.

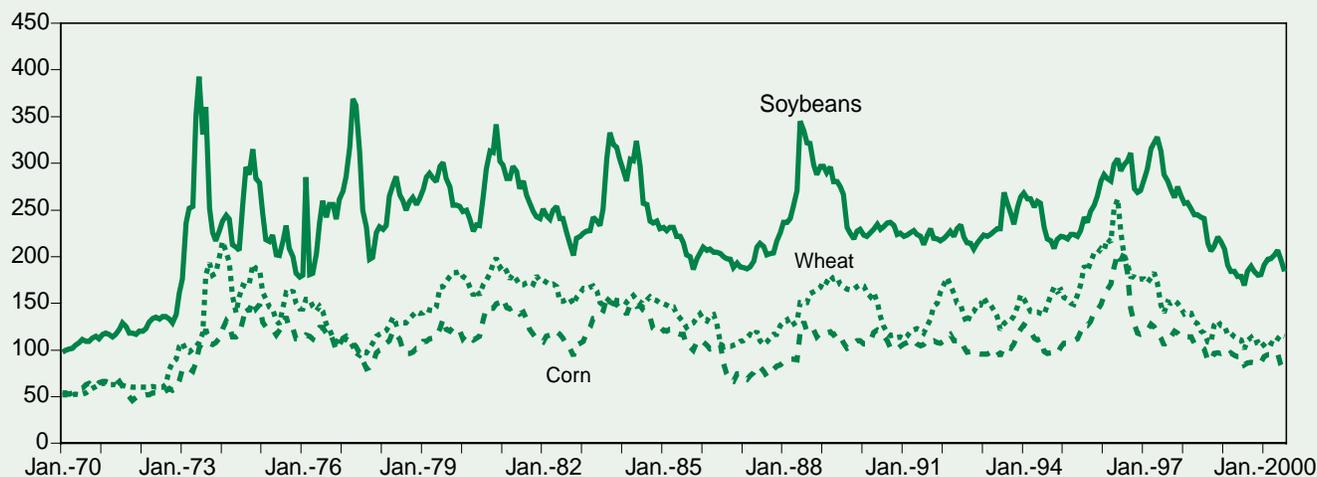
Meanwhile, world demand for grains continued to increase, reflecting robust economic growth in many countries, especially in Asia. A boom in U.S. meat exports bolstered domestic feed use and pushed prices to record heights in the spring and early summer of 1996.

Global grain producers responded to the high prices with sharply expanded plantings and record production in 1996 and 1997.

Figure C-7

### Corn and wheat prices peaked in May 1996, while soybean prices hit a 9-year high in May 1997

U.S. \$ per metric ton



Source: Monthly F.O.B. Gulf port prices; AMS, USDA.

harvesters, and threshers also jumped from an annual average of \$26 million in 1989-91 to nearly \$140 million in 1998 (fig. C-8).

Even after the surge in Argentina's imports, fertilizer and pesticide use per harvested hectare remains small relative to U.S. and Brazilian use (fig. C-9). Argentina still relies on international purchases for much of its chemical inputs and therefore generally pays higher, and more variable, prices for comparable inputs than U.S. producers (fig. C-10). However, recent petrochemical investments could lower input costs and substantially increase fertilizer use. Agrium of Canada, along with the Argentine oil company YPF and the Perez Conglomerate, recently finished a large fertilizer plant at the port city of Bahia Blanca. Since 2000, Argentina has been self-sufficient in nitrogenous fertilizer production. Clearly, higher fertilizer use would allow more intensive cultivation than under the current system of crop-fallow with extensive livestock grazing.

### ***Soybean Production Accelerates Under Reform***

Under reform, soybean production continued to increase rapidly in Argentina, growing at nearly 8 percent per year since 1990, and continuing to accelerate into the late 1990s. However, unlike the substantial yield improvements of the previous two decades, soybean production growth in the 1990s was almost entirely the result of continued area expansion (6.8

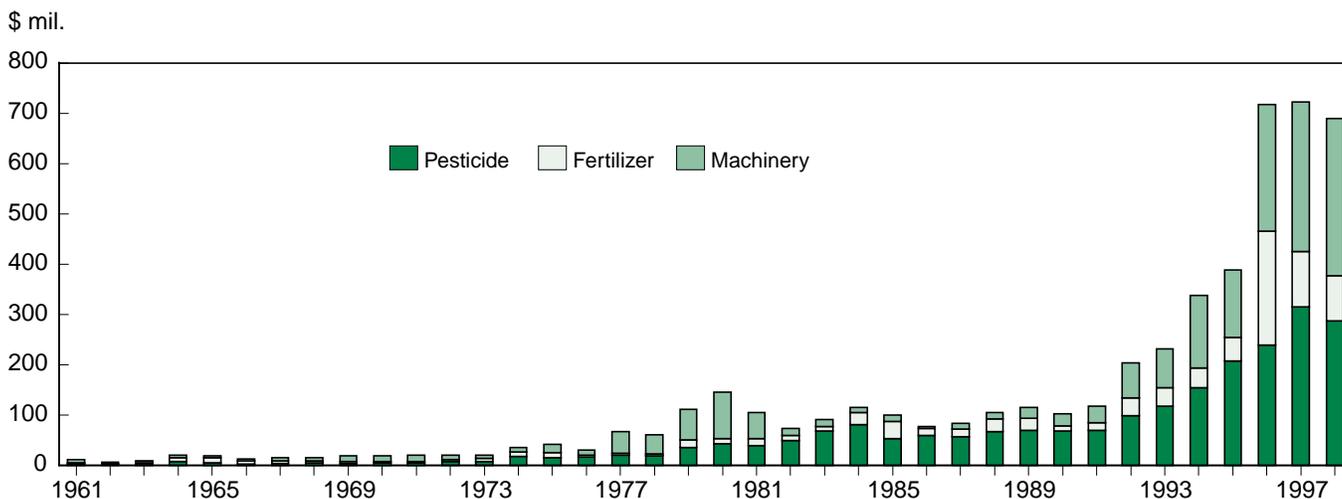
percent annually). Argentina's soybean area has been at year-over-year record levels since 1993 when 5.4 million hectares were harvested. In 2000, 10 million hectares of soybeans were harvested.

Initially, Argentina's soybean area expanded mostly in the central production zone in the heart of the *Pampas*. However, in recent years, the soybean area in the northern and northwestern States has also expanded as infrastructure improvements began to open these states to the major ocean ports of Rosario and Buenos Aires via an overland connection to the Parana-Paraguay waterway at Resistencia (see table C-1 for historical data on field crop production by region).

The rapid expansion of soybean area in Argentina has followed from the widespread adoption of Roundup Ready soybeans in the late 1990s. An estimated 90 percent of Argentina's 2001 soybean crop is planted to biotech varieties, commonly with no-till planting. This compares with an estimated 68 percent of soybean planted acres in the United States during 2001. Producers are clearly motivated by the labor and time savings afforded by Roundup Ready soybean seeds, particularly given the absence of government production subsidies. Cost savings attributable to biotech soybeans are estimated at about \$40 per metric ton, much larger than the \$8-per-ton premium received by producers for non-biotech soybeans in Argentine markets (FAS attache report, 2001).

Figure C-8

### **Argentina's imports of agricultural inputs accelerated after 1991 reforms**

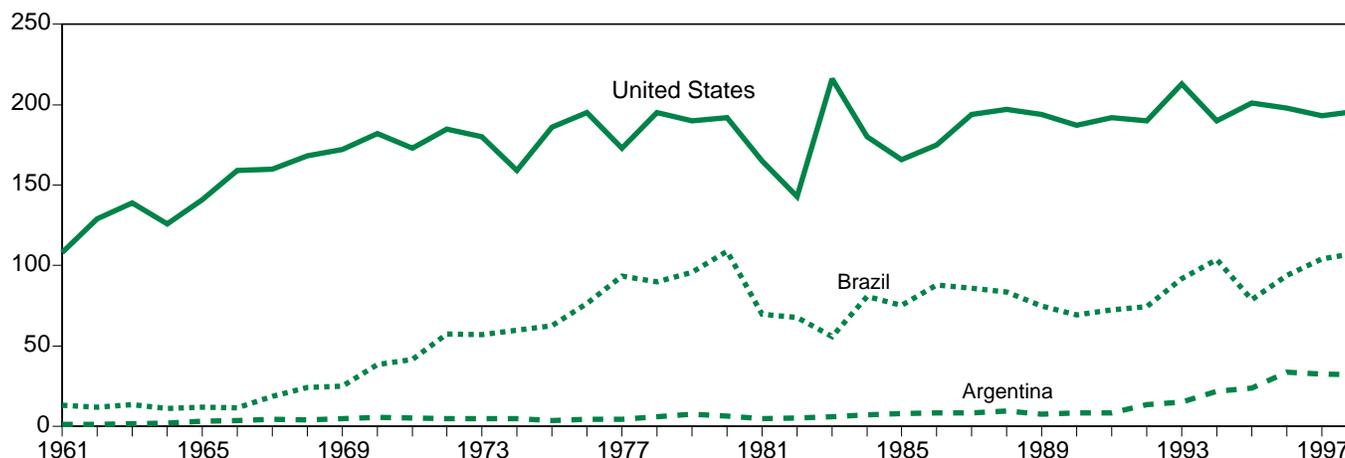


Source: FAO, FAOSTATS; 1961-98.

Figure C-9

**Fertilizer use in Argentina and Brazil still lags far behind the United States\***

Kilograms per hectare

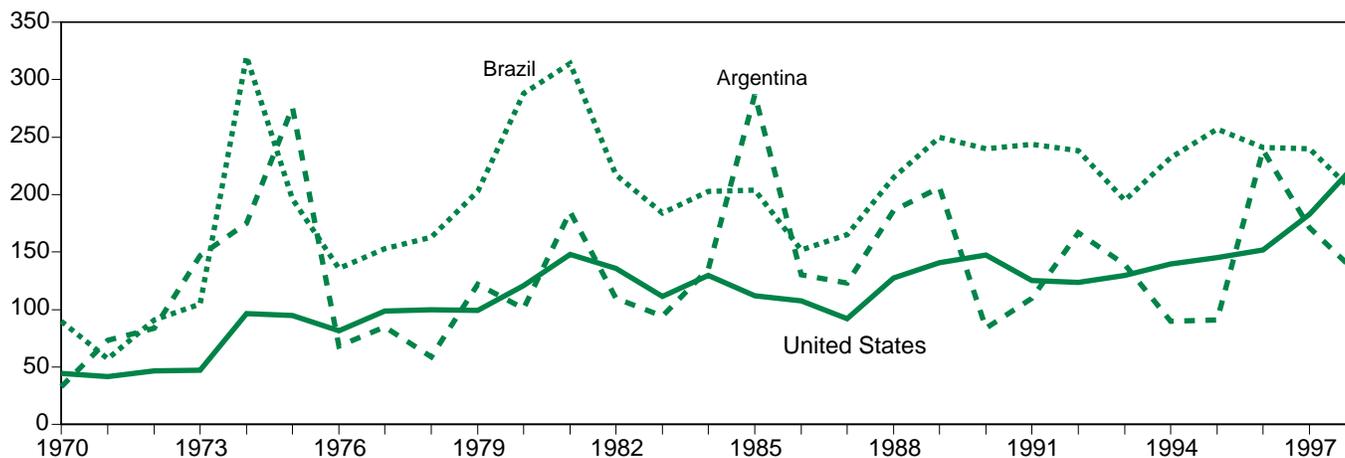


\*Total fertilizer disappearance divided by permanent crop area and harvested area for all field crops.  
 Source: FAO (total fertilizer consumption and permanent crop area); USDA (field crop harvested area).

Figure C-10

**Fertilizer import unit values are significantly more stable in the United States than Argentina or Brazil\***

\$ per metric ton



\*F.o.b. average unit values (all fertilizers) based on import data.  
 Source: FAOSTAT, FAO.

Since 1997, soybean yields in Argentina have been equal to U.S. yields and can be expected to follow a similar growth pattern. Argentine soybean yields have likely received a boost from the adoption of biotech soybeans—which greatly improved weed control—and from the availability of early maturing varieties that help to diminish weather risk. Improved weed control also benefited the subsequent rotational crop (usually corn or winter wheat), while early maturing varieties improved the potential for double-cropping.

The growing presence of major international agribusiness firms has facilitated the rapid acceptance of genetically modified crops by Argentine producers. Similar temperate production climates allow rapid transfer of U.S. technology to Argentina, and many of the same companies supply inputs in both countries. Roundup Ready soybeans have been patented in the United States, but not in Argentina (the patent on the Roundup herbicide expired in 2000). Patenting gives the company greater control in setting prices and restricting a

**Table C-1—Evolution of Argentina's principal field crop plantings by region**

Period	Total	Heart-	South-	North-	North	Other	Heart-	South-	North-	North	Other
		land	west	west			land	west	west		
		----- 1,000 hectares -----					----- Percent of total -----				
<b>Corn</b>											
1970-79	3,807	3,080	458	142	44	84	80.9	12.0	3.7	1.1	2.2
1980-89	3,329	2,531	547	142	49	60	76.0	16.4	4.3	1.5	1.8
1990-94	2,710	2,062	402	126	80	39	76.1	14.9	4.7	3.0	1.4
1995-97	3,773	2,959	424	212	137	42	78.4	11.2	5.6	3.6	1.1
<b>Soybean</b>											
1970-79	713	604	1	50	3	54	84.8	0.1	7.1	0.4	7.6
1980-89	3,377	3,123	11	175	22	46	92.5	0.3	5.2	0.6	1.4
1990-94	5,424	4,934	22	343	108	17	91.0	0.4	6.3	2.0	0.3
1995-97	6,616	6,109	7	372	109	19	92.3	0.1	5.6	1.6	0.3
<b>Wheat</b>											
1970-79	5,229	4,537	578	54	46	14	86.8	11.1	1.0	0.9	0.3
1980-89	5,917	5,313	530	49	17	7	89.8	9.0	0.8	0.3	0.1
1990-94	5,139	4,506	549	52	25	7	87.7	10.7	1.0	0.5	0.1
1995-98	6,124	5,441	564	82	35	3	88.8	9.2	1.3	0.6	0.0
<b>Sorghum</b>											
1970-79	2,678	2,146	282	54	176	21	80.1	10.5	2.0	6.6	0.8
1980-89	1,759	1,199	233	143	167	18	68.2	13.3	8.1	9.5	1.0
1990-94	735	423	181	67	56	8	57.5	24.7	9.1	7.6	1.1
1995-97	798	540	149	70	37	2	67.7	18.7	8.7	4.7	0.3
<b>Sunflower</b>											
1970-79	1,617	1,349	75	3	189	2	83.4	4.7	0.2	11.7	0.1
1980-89	2,182	1,788	239	12	143	0	81.9	10.9	0.6	6.6	0.0
1990-94	2,500	2,046	375	7	72	0	81.8	15.0	0.3	2.9	0.0
1995-97	3,347	2,706	571	17	53	0	80.9	17.0	0.5	1.6	0.0
<b>Feed barley</b>											
1970-79	483	422	26	10	0	26	87.3	5.4	2.0	0.1	5.3
1980-89	194	163	9	9	0	12	84.3	4.5	4.8	0.0	6.4
1990-94	49	41	8	1	0	0	82.0	16.9	1.1	0.0	0.0
1995-97	27	21	6	0	0	0	77.6	21.2	1.3	0.0	0.0
<b>Malt barley</b>											
1970-79	421	364	53	0	0	4	86.4	12.5	0.0	0.0	1.0
1980-89	116	105	9	0	0	2	90.6	7.3	0.0	0.0	2.0
1990-94	194	183	11	0	0	0	94.5	5.5	0.0	0.0	0.0
1995-97	278	243	35	0	0	0	87.5	12.5	0.0	0.0	0.0
<b>Cotton</b>											
1970-79	531	69	0	48	392	22	13.0	0.0	9.0	73.8	4.2
1980-89	429	55	0	27	332	16	12.8	0.0	6.3	77.4	3.6
1990-94	579	43	0	81	440	15	7.4	0.0	13.9	76.0	2.6
1995-97	1,033	55	0	274	685	20	5.3	0.0	26.5	66.3	2.0
<b>Peanuts</b>											
1970-79	331	328	0	1	0	2	98.9	0.1	0.4	0.1	0.5
1980-89	185	184	0	0	0	1	99.4	0.2	0.1	0.1	0.3
1990-94	153	150	0	3	0	0	97.9	0.0	2.1	0.0	0.0
1995-97	241	240	0	0	0	0	99.8	0.0	0.1	0.0	0.1
<b>Rice</b>											
1970-79	94	43	0	1	11	39	45.6	0.0	1.2	11.3	42.0
1980-89	111	50	0	0	7	54	45.0	0.0	0.1	6.2	48.7
1990-94	145	84	0	0	10	49	57.9	0.0	0.0	6.9	34.0
1995-97	229	138	0	0	14	77	60.5	0.0	0.0	6.0	33.6

Heartland is Buenos Aires, Cordoba, Santa Fe, and Entre Rios Provinces; Southwest is La Pampa and San Luis; Northwest is Jujuy, Salta, Santiago del Estero, and Tucuman; North is Chaco and Formosa; and Other includes all remaining Provinces.

Source: SAGPyA (Argentine Ministry of Agriculture and Fisheries.)

product's use. For example, U.S. farmers are required to pay technology fees for the use of Roundup Ready soybean seeds and are not allowed to retain and replant seeds. In contrast, Argentine producers do not pay technology fees, and farmers are allowed to save seeds from one year to the next (GAO, 2000). Consequently, seed costs for biotech soybeans are significantly lower in Argentina than in the United States.

Remarkably, growth in soybean area coincided with stable or expanding planted area for most of Argentina's other major field crops, with the exception of sorghum and barley. This is largely in response to the spike in international commodity prices of the mid-1990s.

Argentina's total harvested area for major field crops jumped from just under 20 million hectares in 1995/96 to over 23 million hectares in 1996/97—a 16-percent increase in a single year (fig. C-11). The total 2001/02 crop harvested area is projected at over 24 million hectares. The stabilization of crop abandonment rates (see box, "Declining Longrun Trend of Field Crop Abandonment in Argentina") at about 13.5 percent of planted area during the 1990s suggests that the gains in total crop area resulted from either new land being added, permanent pasture being converted to field crop production, or shifts in the traditional crop-livestock rotation patterns toward greater emphasis on crops.

### ***Argentina's Oil Crop Processing Industry Also Benefits From Reform***

Since the market and policy reforms of the early 1990s, significant private investments in new, more efficient

technology and expanded capacity have been made in Argentina's oilseed crushing and processing sector. National crushing capacity (per 24 hours) for oilseeds rose sharply from about 58,000 tons in 1994 to an estimated 94,268 metric tons in 2000 (about 63 percent of U.S. capacity). Over 75 percent of Argentina's processing capacity is in Santa Fe, and most crushing facilities are located at or near port facilities.

Because of lower processing costs and their location at the mouth of the Parana-Paraguay waterway, Argentina's processing facilities also serve southern Brazil, Bolivia, and Paraguay, and are strongly oriented toward soymeal and soyoil exports.

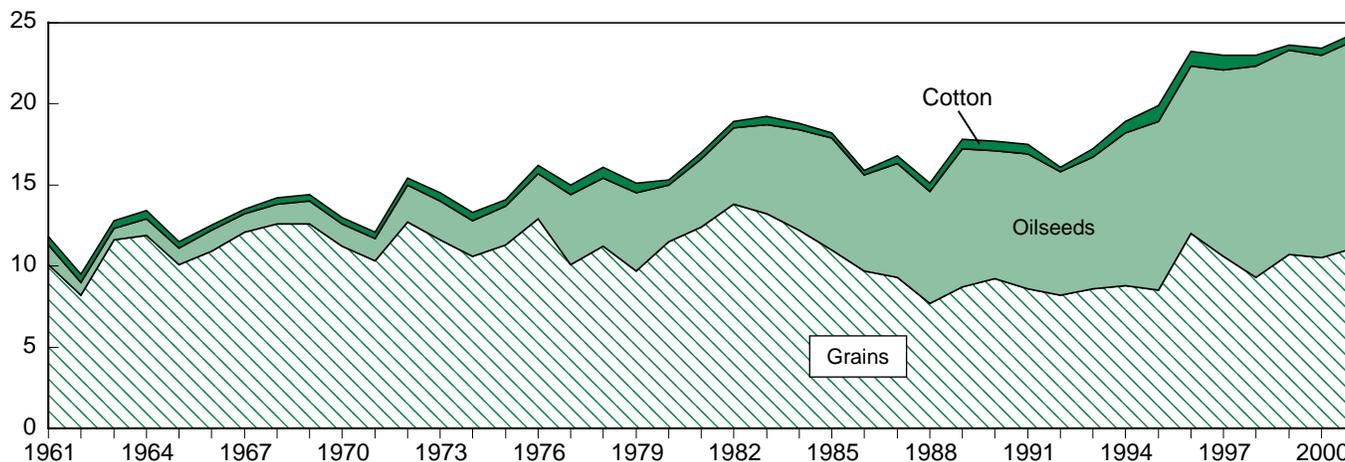
With the development of a more modern, efficient crushing sector, Argentina's soybean exports have given way to an emphasis on the export of soybean products. Accordingly, soymeal and soyoil exports grew at annual clips of about 10 percent each during the 1990s. Argentina has been the world's leading exporter of soyoil since 1995 and the leading exporter of soymeal since 1997, surpassing Brazil in both cases. Argentina's share of global soyoil and soymeal exports was estimated at 35 and 41 percent during 1999-2001, with volumes averaging 13.8 and 3.1 million tons, respectively. However, the vitality of Argentina's crush-sector and export demand for its soybean products has been seriously eroded due to recent policy changes in China.

In July 1999, China imposed a 13-percent value-added tax (VAT) on all imported soymeal to promote its

Figure C-11

### **Argentina's harvested field crop area jumped by 16 percent from 1995 to 1996, and has continued to grow**

Mil. hectares



Source: USDA; August 10, 2001.

## Declining Longrun Trend of Field Crop Abandonment in Argentina

In the past, Argentine producers routinely abandoned (i.e., did not harvest for grain or seed) a significant portion of major field-crop planted area (table C-2). Prior to 1980, abandonment rates averaged over 20 percent of total field-crop plantings. In addition to weather conditions, livestock operations have traditionally been an important determinant of field-crop abandonment rates. Oats and other small grains have often served as cover crops for pasture and winter grazing.

However, abandonment rates of major field crops have been declining over the past three decades, dropping fairly steadily from a 24.5-percent average during the early 1970s to only 13.5 percent in the 1995-97 crop-year period. Declining abandonment is likely related to Argentina's increased integration into world markets as a result of policy reforms. Improved transmission of international prices and higher yields have created incentives to harvest rather than to "graze out" or abandon field crops, and appear to be altering the previous mix of crop-live-stock activities.

**Table C-2—Argentina: Planted area and abandonment by period for major field crops**

Period	All crops	Soy-beans	Sun-flower	Wheat	Corn	Sorghum	Oats
----- Million hectares -----							
<b>Planted area</b>							
1970/71-74/75	16.6	0.2	1.5	4.9	4.3	2.9	1.1
1975/76-79/80	17.6	1.2	1.8	5.6	3.3	2.4	1.5
1980/81-84/85	20.2	2.5	1.9	6.7	3.6	2.5	1.8
1985/86-89/90	18.8	4.2	2.5	5.2	3.0	1.0	1.8
1990/91-94/95	19.5	5.4	2.5	5.1	2.7	0.7	2.0
1995/96-97/98	24.2	6.6	3.5	5.8	3.8	0.8	1.8
----- Percent of planted area -----							
<b>Abandonment</b>							
1970/71-74/75	24.5	6.9	16.4	13.7	20.1	31.1	69.6
1975/76-79/80	20.0	3.6	10.6	9.7	19.2	19.8	72.6
1980/81-84/85	14.6	1.8	3.8	6.4	12.8	7.2	78.3
1985/86-89/90	15.7	5.2	4.4	3.1	21.5	13.3	79.0
1990/91-94/95	13.7	2.2	3.4	4.3	13.4	11.5	81.5
1995/96-97/98	13.5	3.0	4.6	3.2	18.7	16.1	86.5

Source: Secretaria de Agricultura, Ganadería, Pesca, y Alimentación (SAGPyA), government of Argentina.

domestic vegetable oil processing sector. This policy favors the import of whole oilseeds over oilseed products, and resulted in a big shift in the composition of China's soybean imports—China's soybean imports jumped by over 30 percent to 13.2 million tons in 2000, while soyoil imports fell more than 80 percent to 80,000 tons and soymeal imports dropped from 633,000 tons to 125,000 tons.

While soybean producers and exporters in Argentina, Brazil, and the United States have all benefited from the extra soybean demand, their processing sectors saw crushing margins squeezed by the combination of greater crushing capacity and weakened export demand for meal and oil. In 2000, Argentina's soybean

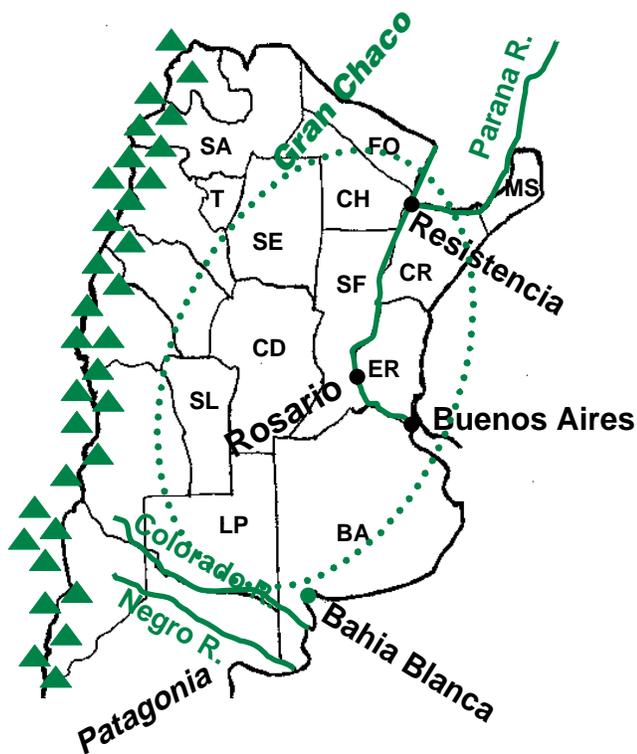
exports to China increased by 189 percent to 2.8 million tons, and Brazil's were up by 146 percent to 2.1 million tons. On the other hand, soyoil exports to China were down sharply for both countries.

### Recent Infrastructure Developments Spur Competitiveness

Argentina's main agricultural producing region lies within 300 kilometers of the country's major ports: Rosario and Buenos Aires (fig. C-12). An additional port, Bahia Blanca in southern Buenos Aires Province, facilitates wheat, sunflower, and other small grain exports from more southerly growing areas. Due to their proximity to ports, Argentine agricultural

Figure C-12

**Most of Argentina's main crop area lies within 300 kilometers of the Parana-Paraguay waterway or a major port\***



\*Refer to figure B-3 for State legend.

Source: Economic Research Service, USDA.

producers have relied almost exclusively on trucks to carry their products to port, despite the fact that trucking is normally more expensive, ton per kilometer, than railway or barge costs.

Argentina's producers also have access to an important inland waterway—the Parana-Paraguay system—which gives much of the principal agricultural production zone almost direct access to oceangoing freighters. The Parana-Paraguay serves all four MERCOSUR nations (Argentina, Brazil, Paraguay, and Uruguay), as well as parts of Bolivia through its principal artery and tributaries. Access points further upriver are served by a system of barges that transport agricultural products downriver to the major ports at Rosario and Buenos Aires.

Several major Argentine grain terminals, all relatively close to grain producers, located along the Parana River have large storage facilities and are able to handle millions of tons of grain annually. Nearly two-

thirds of Argentine exports coming down the Parana river originate in and around Rosario, about 400 kilometers from the Atlantic Ocean.

In the past decade, Argentina's government and private investors have undertaken a number of projects to improve or modernize road conditions, rail networks, waterways, and export terminals. The privatization of all 5 government railroads is beginning to reduce rail costs and improve services. Recent growth in private road development has expanded paved road service to rural areas, but high tolls have made roads costly for movement of bulk grains.

The elimination of the national grain and meat boards, combined with government initiatives to divest itself of Board-owned inland and port facilities, and other privatization initiatives, have increased the efficiency of agricultural production and its associated marketing sectors, thus reducing farmers' costs. In addition, the removal of most government border charges on exports have improved market infrastructure and have helped to narrow the gap between interior and F.O.B. port prices. For example, from 1980 through 1991, the margin between the F.O.B. price of soybeans at Argentine ports and the F.A.S. (i.e., free alongside ship) terminal cash price at Rosario averaged \$68 per metric ton, but has averaged just \$11 per ton since 1991 (fig. C-13). While farmgate-to-terminal costs remain high, the decline in terminal-to-f.o.b. prices translates into strong gains in producer prices and enhanced agricultural production incentives.

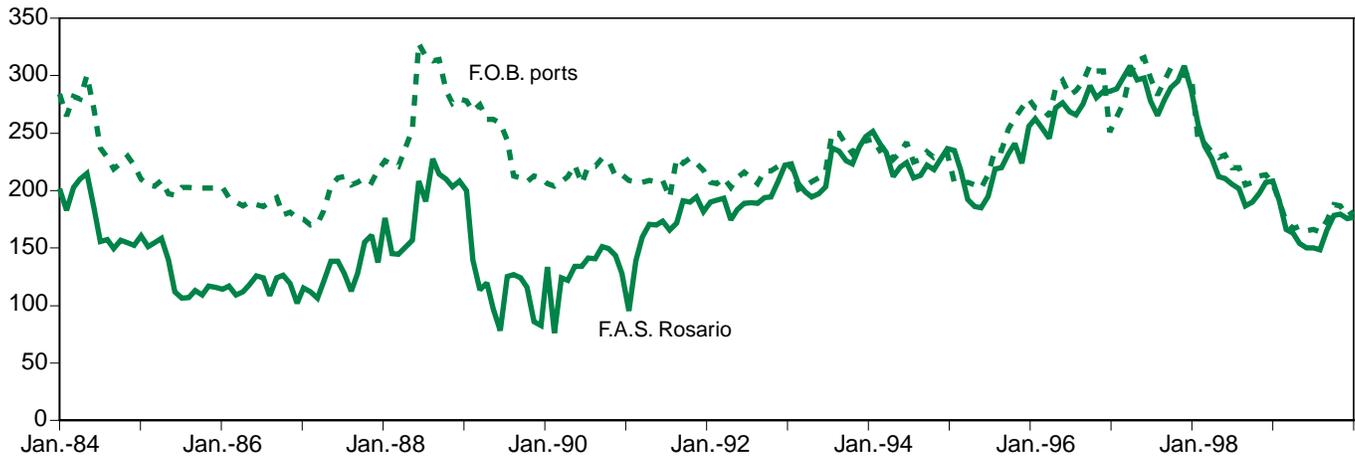
Under privatization, Argentina's port costs (excluding export taxes) have declined from an average of \$8-10 per ton in 1990 to only \$3-5 per ton by 1998, putting it on par with average port costs in the United States (Verheijden and Reca, 1998).

Since 1997, the Parana River has been dredged between Buenos Aires and Rosario, raising the average water depth from about 25 feet to 36 feet. Oceangoing cargo ships of up to 35,000 tons are now able to reach Rosario. Argentina has also started several other dredging projects to deepen the Parana River's main navigation channel, allowing vessels to take on loads up to 40,000 tons (Agriculture and Agri-Food Canada, 1999)—and extending the deepwater navigation channel through the sand bar at the mouth of the Rio de la Plata. These projects, coupled with port privatization, have lowered the cost of Argentine grain on world markets.

Figure C-13

**The gap between F.A.S. and F.O.B. soybean port prices in Argentina has narrowed sharply, reflecting lower port costs and reduced export taxes**

U.S. \$/metric ton



Source: SAGPyA. Free on board (f.o.b.) Argentina ports and free alongside ship (f.a.s.) Rosario terminal prices.

A recent study (Fuller et al. 2000) has identified potential cost savings from three transportation improvements in Argentina: (1) improvements in navigation for oceangoing vessels in the lower portion of the Parana River, (2) improvements in the efficiency of barge transportation on the Parana-Paraguay waterway, and (3) the introduction of privatized rail service giving northwest Argentina access to barge loading facilities at Resistencia on the upper Parana River.

Fuller et al. reported that dredging and associated navigational improvements in the lower Parana River have increased the draft and cargo size for oceangoing vessels, saving an estimated \$5 per ton in transport. The upper Parana River and the Paraguay River have also been dredged to 10 feet, with buoys and other channel markings to facilitate 24-hour, year-round barge travel, as well as to increase tow size and travel time for an estimated saving of about \$1 per ton on transport from points above Rosario. Improvements in these transportation systems are expected to increase producer prices for soybeans in Argentina by nearly \$4 per ton.

In northwestern Argentina—a region that has experienced expanding grain and oilseed production over the past years—a recently privatized rail system will soon be a viable option for transporting grain to Resistencia for barge-loading and to Santa Fe for loading aboard ocean-going vessels. According to one study, post-privatization rail rates have fallen by 40 percent from

pre-privatization rates (Banco Interamericano de Desarrollo, 1996; as cited in Fuller et al., 2000). Further transport cost savings could provide additional incentive for continued expansion of this previously isolated region's agriculture.

**Other Agricultural Sectors Remain Vital to Soybean Prospects**

This section presents developments in other agricultural sectors that have been integral to the evolution of Argentina's soybean sector. These include corn, wheat, rice, and cotton, as well as the livestock sector.

***Corn Production Doubles During 1990s***

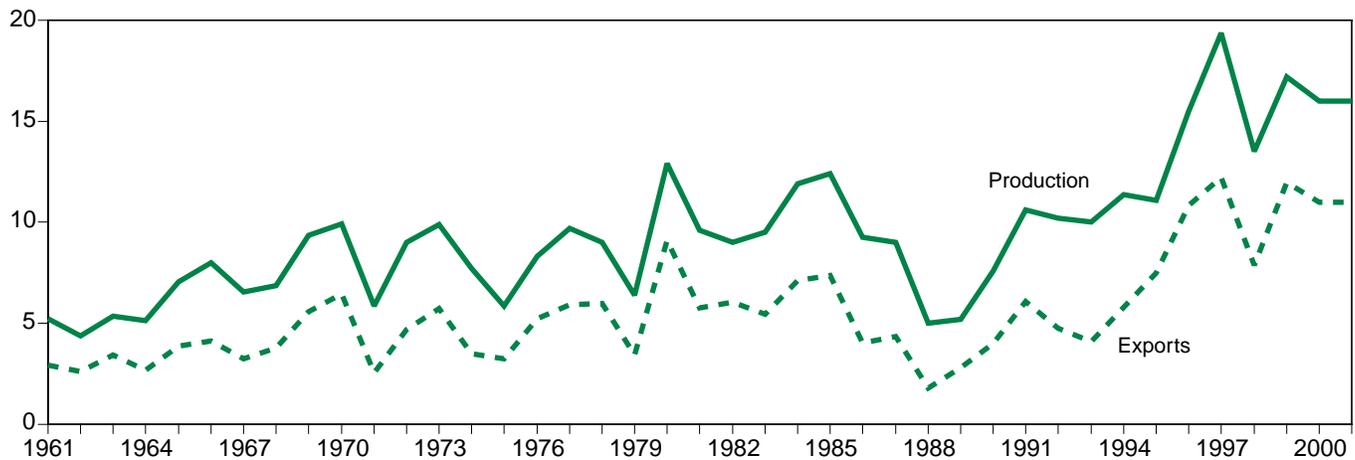
As with soybeans, Argentina is a major player in the international corn market. In 2000, Argentina was the sixth-ranked global corn producer and second leading corn exporter behind the United States. Although global corn trade is traditionally dominated by the United States, Argentina is one of only two non-U.S. sources (along with China) that consistently exports corn into international markets.

Since the early 1990s, Argentina's corn production, exports, and world market share have increased on the strength of both rapid annual area and yield growth (3.8 and 4.1 percent, respectively) (fig. C-14). Argentina's share of world corn exports more than

Figure C-14

**Argentina's corn production and exports have strongly rebounded from a decline in the late 1980s**

Mil. metric tons



Source: USDA; August 10, 2001.

doubled from a 6-percent average during 1989-91 to a 13.2-percent average during 1999-2001.

Many of the same forces shaping Argentina's soybean sector are influential in the corn sector. Argentina possesses excellent land resources for corn production, and its Southern Hemisphere production cycle provides a strong seasonal competitiveness to its corn exports. In addition, a small domestic market contributes to a strong export orientation. As a result, gains in Argentine corn production translate almost directly into increased exports and greater market share.

Prior to economic and political reforms in the early 1990s, the strong export orientation of Argentina's corn sector left it vulnerable to government policies that taxed agricultural exports and limited access to imported technology and inputs. Argentina's corn area peaked in 1970 at 4.9 million hectares planted (4.1 million harvested), then dropped to only 1.7 million hectares harvested in 1988 and 1989 as weak international corn prices (relative to soybeans) dampened incentives to produce corn. Since the early 1990s, however, Argentina's corn production has been recovering. Production hit a record 19.4 million tons in 1997 when strong international market prices motivated intensive input applications and significant area substitution in favor of corn. Corn yields also attained a record 6.1 tons per hectare (77 percent of U.S. yields) in 1997, but harvested area at 3.2 million hectares remained far below its 1970 peak.

Significant yield growth potential remains to be captured in Argentina for corn. Argentina's corn yields rose nearly 50 percent between 1990/91 and 2000/01, but are still only two-thirds of average U.S. yields (fig. C-15). Expanded plantings of biotech soybeans have helped with weed control in corn-soybean rotations. In addition, varietal improvements and gradually increasing fertilizer use explain much of Argentina's recent corn yield increases. Future yield gains will depend largely on further increases in fertilizer use.

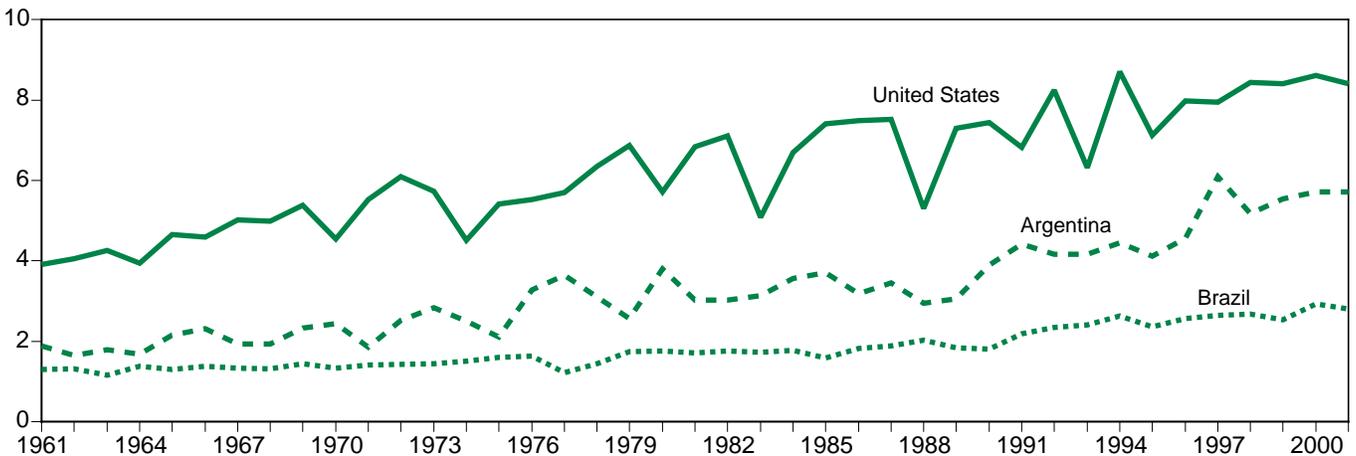
Argentine farmers have also adopted biotech corn varieties. An estimated 20 percent of the 2001 corn crop is planted to insect-resistant (Bt) corn varieties, all of which are approved by the European Union. This compares with an estimated 26-percent share for biotech corn varieties in the United States in 2001. Since 1998, Argentina has pursued a policy of approving new corn hybrids only after they are approved in major export markets (particularly the EU and Japan).

Since 1998, weak corn prices have contributed to a falloff in production. Some area has shifted to soybeans, and producers have had less incentive to apply fertilizer and chemical inputs. Argentina's corn growers remain very sensitive and responsive to price relationships between crops and inputs that govern profitability. For example, Argentine producers are aware of the growing feed demand in Brazil (a major destination for Argentina's corn exports) and are likely to respond to any shift in regional incentives.

Figure C-15

**Corn yields in Argentina and Brazil still lag behind U.S. yields, mainly due to low input use**

Metric tons/hectare



Source: USDA; August 10, 2001.

U.S. and Argentine corn growers differ widely in abandonment rates. Abandonment of planted corn area is more common in Argentina than in the United States (18 percent versus about 8 percent) and significantly more variable, ranging as high as 37 percent of total corn area in 1988/89.

**Argentina Is the World’s Fifth-Leading Wheat Exporter**

Argentina has been a consistent wheat exporter throughout the past four decades. Argentina’s share of global wheat exports more than doubled in the past decade, from 4.9 percent during 1989-91 to 10.2 percent in 2001. As with its entire grain sector, Argentina’s wheat industry has a strong export orientation due to a small domestic market, almost no domestic feed use of wheat, and proximity of production to port facilities. Brazil is the principal wheat export destination.

Argentina’s wheat sector has ebbed and flowed over the years with changing market conditions. Wheat harvested area peaked in 1982 at 7.3 million hectares, declined to 4.2 million hectares harvested in 1992 (in response to low international prices), and is expected to reach 6.8 million hectares in 2001/02 based on improving profitability. Although harvested area declined after 1997 in response to weaker prices and more favorable returns to other crops, wheat production remains robust and yields have benefited from the adoption of improved French varieties in recent years (fig. C-16). Argentina’s 2001

wheat production is projected at a record 17.5 million tons, with a record 13 million tons projected to move into export markets (fig. C-17).

**Minor Oilseed Crops Grow at Expense of Minor Coarse Grains**

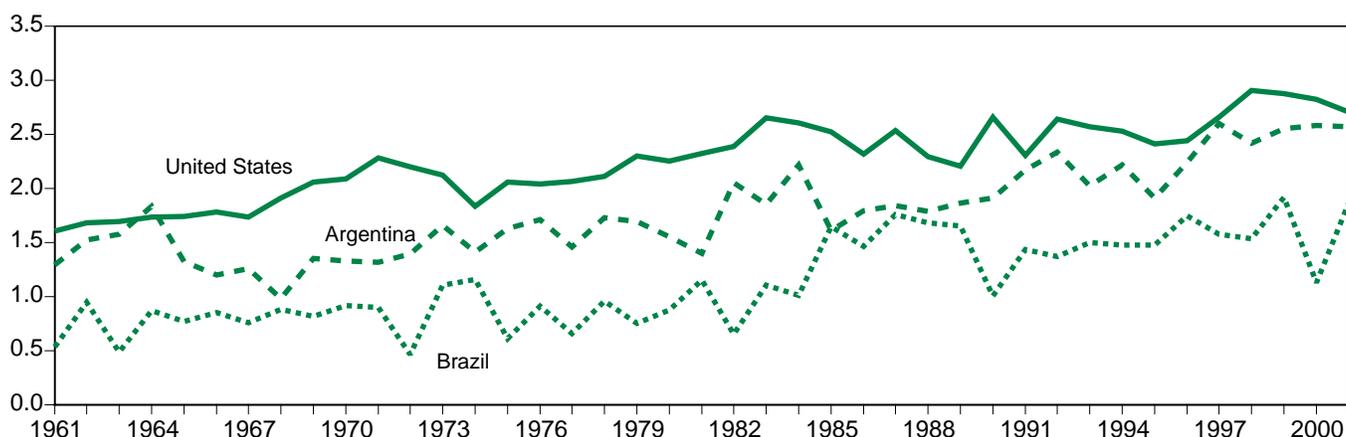
Argentina’s principal noncorn feed grains—sorghum and barley—both experienced declines since the early 1970s, when sorghum planted area exceeded 3 million hectares and barley 1 million hectares (about half planted to feed barley). Limited domestic feeding and modest international demand weakened the relative profitability of minor coarse grains and motivated much of the decline. In 1995-97, Argentina’s sorghum plantings averaged about 800,000 hectares while barley plantings averaged only about 300,000 hectares (over 90 percent of which was planted to malting barley). Argentina has been the world’s second leading sorghum exporter in recent years, far behind the United States, but conducts very little trade in barley.

Argentina’s other major oilseed—sunflower—had also enjoyed a steady surge in plantings and production since the late 1980s. Plantings exceeded 4 million hectares in 1998, having more than doubled since 1986. Production was bolstered by strong yields from hybrids. However, weak international vegetable oil prices have reduced plantings since 1998, and harvested sunflower area was estimated at only 1.9 million hectares in 2000/01. Argentina has consistently been the world’s leading exporter of sunflower oil and

Figure C-16

**Argentina has closed the wheat-yield gap with the U.S. since the mid-1990s**

Metric tons/hectare

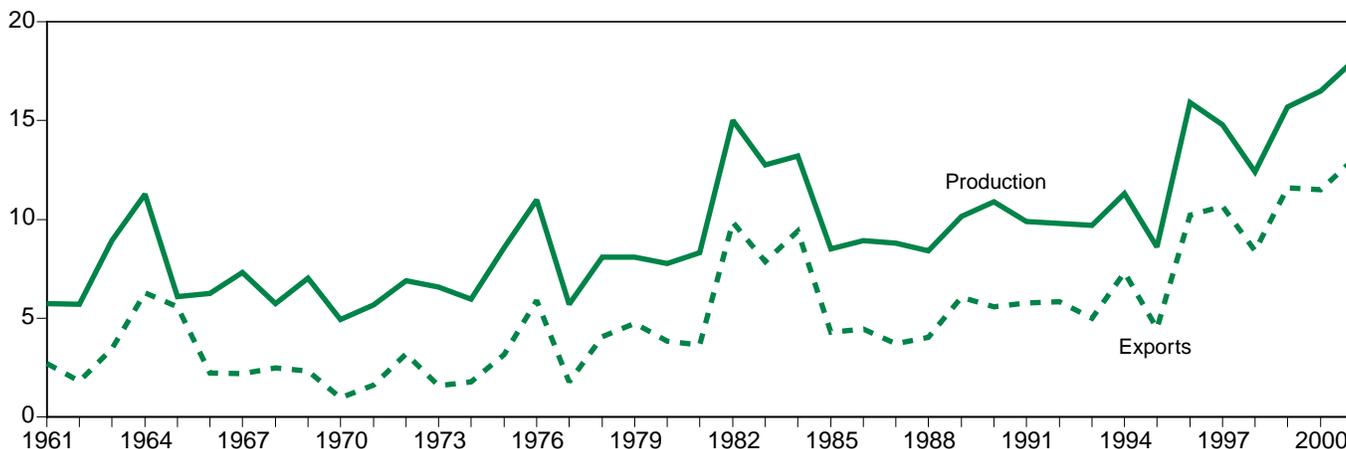


Source: USDA; August 10, 2001.

Figure C-17

**Argentina's wheat sector has rebounded, with production and exports reaching new highs**

Mil. metric tons



Source: USDA; August 10, 2001.

meal but, as with production, sunseed exports have been very erratic—about 900,000 tons in 1994 and 1998, but only 120,000 tons in 2000.

In Argentina, peanuts are an important minor oilseed crop. Peanut production generally requires a frost-free period of 180-200 days with warm temperatures and light soils. As a result, peanut production takes place almost entirely in central Cordoba, making it a competitor with wheat and soybeans. Therefore, peanut planted area is highly variable in response to relative crop prices and returns. For example, plantings in 1992 were only 110,000 hectares, compared with a

record 407,000 hectares in 1997 and an anticipated 230,000 hectares in 2000/01. Argentina was the world's leading peanut exporter in 1997 and has ranked second or third since.

Most of Argentina's cotton production occurs in the northern Provinces of Chaco and Santiago del Estero, where, under normal circumstances, good cotton-growing conditions often preclude production of other field crops. However, Argentina's cotton industry suffered in the late 1990s due to low international prices, poor weather, and an overvalued exchange rate relative to the Brazilian currency. As a result,

Argentina's cotton harvested area has plummeted from just under 1 million hectares in 1995 to 300,000 hectares in 1999 and 380,000 hectares in 2000.

Most rice production is undertaken in the northeastern Provinces of Entre Rios and Corrientes. Rice production is almost entirely irrigated and, as with cotton, very little cross-commodity competition for land occurs in the principal rice-growing zone. As with most of Argentina's agricultural output, rice is grown principally for export. Again, Brazil is the principal destination. Rice producer incentives have mirrored those of cotton the past several years, with weak international prices and lack of government support curbing plantings. Harvested hectares fell from a record 289,000 in 1998 to only 133,000 in 2000.

Brazil's large exchange rate devaluation in early 1999 underscored Argentina's dependence on the Brazilian market, as both rice and, to a lesser degree, cotton exports fell sharply in 1999.

### ***Livestock Dynamics Play Critical Role in Determining Field Crop Potential***

Livestock dynamics will be critical to the longrun evolution of field crop production in Argentina as much of the country's land is used to support the world's fifth largest cattle population—annual cattle inventories averaged about 55 million head during 1998-2000.

Production of beef and veal dominate Argentina's livestock sector, although poultry production has more than doubled in the past 10 years. The sheep industry remains important, but has been in steady decline since 1970 (table C-3).

Argentina has enormous tracts of permanent pastureland (estimated at over 142 million hectares) that support a largely grass-fed cattle population. Argentina's large cattle herds, predominantly steers and feeder heifers, compete with field crops for

grazing land in the principal production areas. Most of the cow/bull population is in the central Buenos Aires Province. The Salado Basin in central-east Buenos Aires Province is a traditional cow-calf area, where some conversion from pasture to crops occurs under favorable circumstances. A large portion of cow-calf operations and most of the sheep population are spread out further into the marginal lands of western and southern Argentina. At the same time, crop production and cattle raising are considered highly complementary, given the practice of rotating crops with sown pastures to maintain soil fertility.

In the western edges of Argentina's agricultural zone, where the productivity of fertile soils is tempered by drier, more variable precipitation conditions, the tradeoff between pasture and field crop cultivation hinges on market conditions. However, even a very minor shift of pasture into field crop cultivation could have a large impact on total area and production. For example, a shift of just 7 percent of permanent pasture into field crop cultivation would bring about 10 million hectares (equivalent to the average annual total planted area of Iowa) into production, with potentially enormous consequences for international grain markets. Nevertheless, until significant feedlot expansion occurs, shifts between permanent pasture and cropland will probably only occur at the margin.

Argentina has had the world's highest per capita beef consumption for several decades, but it has been trending down the past 15 years, falling from 85 kilograms per capita in the mid-1980s to about 68 kg/capita by the late 1990s. At the same time, lower cost feeding facilities producing younger animals with lighter finishing weights have expanded recently. These patterns, combined with limited population growth, portend a continued decline in domestic beef demand.

Beef export prospects appeared to receive a boost in 2000 when Argentina was declared foot-and-mouth disease (FMD) free. Argentina's beef producers conse-

**Table C-3—Livestock populations and meat production in Argentina**

Period	Population				Meat production			
	Cattle	Pigs	Sheep	Goats	Beef & veal	Pork	Mutton & lamb	Poultry
	----- Million head -----				----- 1,000 metric tons -----			
1968-70	49.4	4.0	44.4	5.3	2,689	199	193	157
1978-80	56.8	3.6	32.2	3.1	3,018	245	124	291
1988-90	52.6	2.8	29.0	3.2	2,691	168	84	375
1998-2000	54.9	3.2	14.4	3.4	2,652	156	46	927

Source: FAOSTATS, FAO.

quently could target the high-end foreign markets that traditionally consume “grain-finished” beef. However, this potential was short lived due to the April 2001 confirmation of a new outbreak of FMD in Argentina. It will be several years before unprocessed meat exports to countries free of FMD can be resumed. Strong income growth would likely need to occur in international markets before red meat trade experiences the type of takeoff necessary to trigger the development of feedlots “à la United States” in Argentina.

## **Argentina’s Post-Reform Economy... Losing Stability?**

Argentina’s reform programs laid the groundwork for a stable investment climate for agriculture by quelling inflation and establishing confidence in the peso. The reduction of export taxes, import tariffs, and quotas allowed domestic producers to capture a larger share of international market prices, and allowed more of Argentina’s surplus agricultural production to flow into export markets. Argentina’s economy performed well throughout much of the 1990s—annual GDP growth averaged 8 percent during 1991-98, while consumer price inflation has hovered near zero since 1996. Despite four major international financial crises—the 1995 Mexican peso crisis, the 1997 Asian crisis, the 1998 Russian crisis, and the 1999 Brazilian crisis—Argentina has managed to maintain its currency peg to the U.S. dollar.

Nevertheless, the reforms of the early 1990s left many significant problems unresolved and Argentina is now in the midst of a 4-year recession. The economy is still burdened by excessive regulation and labor market rigidities. Employers have little flexibility in firing employees, lowering wages, or hiring part-time labor. As a result, high payroll costs hinder international competitiveness for many sectors. Although significant privatization occurred under reform, in many cases privatization simply involved substituting a privately owned monopoly for a government monopoly with little gain in competition or efficiency.

The Government of Argentina (GOA) employs nearly one-third of the labor force. Despite some initial cuts, government payrolls remain large in 2001, and government expenditures have exceeded revenues since 1995. Rather than cutting expenditures, the GOA has raised taxes in an attempt to reduce the fiscal deficit, which has raised business costs. The mounting public debt—\$130 billion in June 2001—undermines investor confi-

dence in the country’s ability to manage its economy and poses a serious threat to economic stability as much of the debt is financed through short-term credit from international financial markets.

These economic problems are finally catching up with Argentina. The economy has been mired in recession since 1998 with no sign of recovery in the near future, and unemployment has been running at about 15 percent. Significant currency depreciation in Brazil and currency weakness in the European Union (both major trading partners) suggest that the value of the peso has become too high. Meanwhile, the trade-weighted value of the U.S. dollar has risen to near-record levels, further strengthening the peso (whose value is linked to the U.S. dollar).

The current economic outlook in Argentina is for another round of inflation. After negligible inflation during 1996-2000, private forecasters project inflation of 6 to 10 percent during 2002-03. As inflation in Argentina outpaces that in the United States, the peso becomes even more overvalued.

### ***Partial Devaluation of the Peso?***

The GOA has been under pressure for some time to consider changing back to a pegged-float or even a free-float exchange rate. On June 15, 2001, Argentina’s economic minister, Domingo Cavallo, announced a package of policy measures referred to as the convergence factor. This package included the introduction of a dual exchange-rate system with an indirect devaluation for commodity exporters through implementation of a set of trade policy tools. Cavallo’s plan also includes an austerity program designed to eliminate the government deficit. The overall package of measures is intended to boost international competitiveness and revive growth, while avoiding a potentially disastrous default on government debt.

Currency devaluation has always been an obvious remedy for Argentina, but has been avoided due to the country’s enormous government debt. As long as the peso is pegged one-to-one with the dollar, the \$130 billion debt can be repaid with 130 billion pesos. A 10-percent devaluation would raise that price to 143 billion pesos. Cavallo’s enhanced convertibility law tries to have it both ways by cutting the impact of currency overvaluation on exporters while retaining the ability to repay international debt with the overvalued peso.

Under the new plan, international finance operates under the usual one-peso-to-one-dollar arrangement, but exporters receive an adjustable reimbursement by the GOA in amounts equal to the difference between the current peso-dollar peg and a peso exchange rate based on a 50-50 mix of the euro and the dollar. For example, during July 2001, the euro traded at about 14 percent below the dollar (1 euro = U.S. \$0.86), so the devaluation for exporters would be roughly 7-percent. On the other hand, importers face what amounts to an implicit tariff of equal magnitude under the new system. The devaluation-induced export gains are to be partially offset by elimination of export tax rebates, while the devaluation-induced higher import costs are to be partially offset by lower tariffs on imports.

If successful, Cavallo's exchange-rate adjustment plan could mean potential gains in Argentina's share of international trade due to lower priced exports. However, of greater concern is the risk of deepening recession and the possibility of a regional spillover of economic difficulties into Brazil and beyond.

*MERCOSUR*—a regional customs union among Argentina, Brazil, Paraguay, and Uruguay—has increased economic ties among member countries by establishing essentially duty-free trade within the union. But the interdependence of trade among members has made each country more vulnerable to each other's economic problems. For example, depreciation of Brazil's currency has made many of Argentina's commodity exports relatively less competitive. In addition, high common external tariffs have sheltered inefficient industries from competition abroad.

Argentina's farmers are not optimistic about the new policies even though there are some positive aspects for agriculture. For example, taxes on interest payments on credit are to be eliminated, payment of a banking transaction tax and fuel transfer tax are to be deductible against farmers' value-added tax liabilities, and there are plans to lower costly highway tolls by up to 60 percent.

However, diesel fuel prices are to be raised by over 15 percent. According to Argentine sources, every centavo (1/100 peso) increase in the price of diesel fuel costs farmers an additional US\$45 million per year. In addition, farmers are dependent on imports of many important agricultural inputs such as farm chemicals and machinery. Import costs would increase under the dual exchange-rate system. In the end, the proposed exchange rate could simply accelerate the process of squeezing out

less efficient or less well-financed operators, which has been underway in Argentina for most of the past decade.

The bottom line for international commodity markets is that Argentina's wheat, corn, soybeans, soymeal, and soyoil could cost less relative to competitors under the new exchange-rate mechanism. This could mean market share gains for Argentina and greater pressure on international commodity prices in general. If the GOA decided to let the peso float freely (as in Brazil), the currency's value would likely drop 25 to 30 percent, perhaps temporarily overshooting to as much as 50 percent in the beginning.

### *What's Ahead for Argentina's Economy?*

Some commodity markets are still recovering from the last global crisis—the 1997 Asian crisis. Argentina's ability to finance its debt is important for global financial stability because more than 20 percent of all tradable emerging-country debt originates in Argentina. However, the ties between Argentina and other emerging economies are not tight, except with Brazil. Although the possibility of impacts in Latin America exists, the overall risk of spillover is relatively low.

Nevertheless, concerns have been raised in international money markets that Cavallo's announcement merely signals the possibility of even larger currency devaluation and further enlargement of Argentina's debt crisis. Much of Argentina's government debt is short-term credit that will need to be repaid or refinanced soon. Cavallo's policy package is only part of a recent series of measures taken to avoid an economic crisis similar to the 1980s, which was due to the inability of the government to repay or refinance its debt. In December 2000, the GOA received a \$40-billion rescue package from the IMF and other sources to temporarily hold off its mounting debt crisis. In May 2001, the GOA traded \$30 billion in short-term credit for long-term bonds to defer repayment and ease the immediate burden.

Argentina's debt problems will not disappear anytime soon. The country will need to raise about \$12 billion in 2002 to repay or refinance more short-term debt coming due. This dilemma is compounded by the likelihood of a deepening recession. However, if Cavallo's austerity plan and labor market reforms are followed by the Provincial governors, it could help restore investor confidence and build the foundation for future economic growth.

# Soybeans, Agriculture, and Policy in Brazil

## Introduction

**B**razil's vast territory encompasses two separate and distinct regions engaged in field crop and live-stock production—the temperate South and the broadly defined, tropical “Center-West.” The South comprises the three States of Brazil's southeastern corner—Rio Grande do Sul, Santa Catarina, and Parana. Brazil's official Center-West region encompasses Mato Grosso, Mato Grosso do Sul, Goias, and the Federal District surrounding Brasilia.<sup>1</sup>

Both regions—South and Center-West—are distinguished by differences in climate, cropping patterns, and other farm characteristics, particularly farm size. Within both of these regions, the major field crops—corn, soybeans, wheat, rice, and cotton—compete for agricultural resources with livestock, tree crops (principally coffee and oranges), sugar cane, and food crops (e.g., pulses, tubers, and vegetable crops), demand for which is being driven by Brazil's huge population.

An abundant natural resource base remains a major, long-term economic strength for Brazil but, like Argentina, the development of the agricultural sector has been hindered by an historically unstable macroeconomic environment. High inflation, a heavy external debt burden, high interest rates, and periods of severe currency overvaluation created a very unfavorable investment climate for agricultural development. In addition, import tariffs on agricultural inputs and export taxes on most agricultural products distorted production incentives and constricted agricultural productivity growth.

With respect to Brazil's agricultural sector, this unstable economic environment was aggravated by

social policies that tended to favor domestic consumers and processors over export-oriented producers. Brazil's burgeoning, urbanized, and predominantly lower income population traditionally pressures politicians to keep food supplies cheap and abundant. To this end, policymakers have used export and price controls and otherwise intervened, with the general effect of lowering farm-level prices and dampening producer incentives.

However, in the midst of this economic and policy tangle, Brazil's Government promoted the soybean sector for a variety of reasons and with a mixture of often conflicting policies. The result has been a sustained soybean area expansion, driven predominantly by new land entering production in the Center-West. Much of Brazil's yield growth is also associated with this region, where large-scale farms apply the full suite of modern inputs and technology and achieve significant economies of scale.

Beginning in the early 1990s, Brazil slowly began implementing economic reforms designed to reduce or eliminate government controls and interference in the marketplace and allow for a more efficient allocation of the nation's resources. The evolution of these reform policies is ongoing but, for the most part, they have helped to stabilize the economy and create a more liberal policy regime favorable to agricultural investment, production, and exports. The policy reforms have benefited the soybean industry and, with the removal of many trade barriers, have furthered Brazil's ascendance in international soybean and soybean product markets.

This chapter provides an overview of the evolution of Brazil's soybean sector, within the context of macroeconomic and agricultural policy developments from pre-reform through the reform period of the 1990s. Included is a discussion of transportation and marketing infrastructure issues vital to the expansion

<sup>1</sup> However, the “Center-West” may be more broadly defined as the set of interior States that include Rondonia and parts of Minas Gerais, Bahia, Tocantins, Piaui, and Maranhao since all of these States share the common feature behind the Center-West's agriculture—i.e., development of the *cerrado* land, principally for soybean production.

of the agricultural sector as well as developments in competing field crop and livestock sectors.

## **Brazil's Soybean Sector Grows With Strong Government Support<sup>2</sup>**

### ***Introduction***

Brazil is the world's second-leading producer and exporter of soybeans and products (soybean meal and soybean oil), trailing the United States in soybean production and export and Argentina in the export of soybean products. However, soybeans were late to join the ranks of major field crops produced in Brazil. In the 1960s, soybeans (like most row crops) were grown predominantly on small farms in the South.

Brazil's soybean industry initially benefited from a period of rapid growth in world soybean demand during the 1960s and 1970s. However, the Brazilian Government (GOB) also maintained policies that facilitated industry expansion by favoring soybeans in particular, and the development of the immense interior *cerrado* region in general.

### ***Brazil's Government Develops Import-Substitution Strategy***

Early in the post-WWII period, the GOB implemented an import-substitution strategy to promote domestic economic growth while limiting foreign debt and the use of foreign exchange. To this end, Brazil's agricultural sector was heavily taxed using both direct and indirect policies in an effort to supply the urban sector—consumers and processors—with cheap agricultural products. Export quotas and licenses, as well as prohibitions on trade, were applied sporadically, often in combination with direct export taxes, to Brazil's major agricultural commodities.

Imports of agricultural inputs were also controlled through licenses and other restrictions. As a result, the agricultural sector had to pay high prices (well above international market prices) for fertilizer, chemical, and machinery inputs produced by domestic manufacturers. In addition, GOB currency controls resulted in a highly overvalued exchange rate, adding further disincentives to agricultural production.

<sup>2</sup> This section draws heavily from Warnken's comprehensive book on Brazil's soybean sector (Warnken, 1999).

## ***Various Motives Spur Government To Promote the Soybean Sector***

Despite relying on the agricultural sector to finance the development of other sectors, the GOB did single out the soybean sector for special treatment. Several development-related motivations emerged during the 1960s and 1970s that favored the soybean industry (Warnken, 1999).

A primary motive was to save and increase foreign exchange. Brazil's population and food demand had grown rapidly, and vegetable oil imports began to account for an increasing share of limited foreign exchange. By the late 1960s, the GOB saw increased domestic soybean production as a means of displacing soybean oil imports. By establishing policies supportive of the domestic processing industry and soybean production, the GOB also hoped to encourage exports of value-added agricultural products, particularly soybean meal. Growing international demand for protein feeds further encouraged this strategy.

A second motive was to hold down domestic food prices and improve diets. Soybean oil was one of the four most important food items for low- to low middle-income families, and was very influential in the calculation of Brazil's consumer price index. As a result, soybean oil prices were critical to national food policy in Brazil's highly inflationary environment. Government interest in holding down food prices begat policies to ensure domestic supplies of low-priced soybean oil. With a large, generally low-income population, the Brazilian Government also took steps to increase animal protein consumption by stimulating domestic poultry production, which expanded soybean demand.

Third, the soybean industry was viewed by the GOB as one of the principal engines for stimulating growth in the agricultural processing and input industries. An abundant supply of cheap soybeans were needed to fuel the processing sector's growth, while expanded plantings would benefit the input industry.

A final motive for supporting soybean production was the preservation of territorial integrity. Brazil's military government saw the majority of its vast land areas as essentially uninhabited. Most of Brazil's population and agricultural production was situated along the eastern and southeastern coastline. With the increasing strength of neighboring nations, the GOB felt compelled to better integrate western States into the national economy by opening this area to agricultural production.

## ***Soybeans Benefit From Government Policy and Land Expansion***

In the 1960s, Brazil's Government began implementing policies designed to directly and/or indirectly support the soybean industry. These policies included publicly funded agricultural research and development, guaranteed minimum price supports, production and marketing credit programs, agricultural input production and use subsidies, public infrastructure programs, and supportive energy and taxation policies. In addition, several national programs oriented toward other crops (e.g., wheat, coffee, and sugar cane) also indirectly promoted soybean production.

**Publicly Funded Agricultural Research and Development.** Brazil's national network of agricultural research and experiment stations—EMBRAPA (Brazilian Agency for Research on Agriculture and Animal Husbandry)—working closely with private agricultural research groups, has played a critical role in the expansion of field crop and livestock production from the temperate South into the tropical Center-West. One of its greatest successes has been the development of the tropical soybean. Soybean plants are among the most sensitive of all common crop plants to day length and light intensity. The highly “latitude-sensitive” soybean varieties give best full-season production in a zone usually no wider than 150 to 250 km (90 to 150 miles). Brazil's EMBRAPA developed a soybean variety that flourishes in the tropics' shorter day length and mild, wet climate. Under optimal conditions, Brazil's tropical soybean produces yields of 4.7 to 5.4 metric tons per hectare (70 to 80 bushels per acre), compared with Brazilian national average yields of about 2.5 tons per hectare. EMBRAPA has also made important improvements in tropical corn and cotton varieties, enhancing their adaptability to *cer-rado* soils and climate.

**Uniform National Price Support and Energy Pricing Policy.** Although agricultural inputs remained protected from imports, the Government worked to reduce the burden on the country's agricultural sector. The GOB's national price support policy and national energy price policy contributed to this effort.

Just prior to the planting season each year, the GOB announced support prices—i.e., minimum price guarantees—for primary crops, including soybeans. To shore up crop production, particularly in the Center-West, national commodity support prices were set uniformly

for the entire country despite the generally lower farm-gate prices in more remote areas. This uniform support price policy remained in effect until February 1994 for corn and February 1995 for soybeans.

For soybean producers in the South near the major processors and ports, low marketing costs from farm-gate to port generally meant that local prices were above the relatively low government support price. Only in 2 years out of the past 30 has the national average soybean price fallen below the government support price; thus, the program has not been used much by farmers in the South (fig. D-1).

In contrast, Center-West soybean producers have been more isolated from southeastern seaports and usually faced very low farm-level prices due to high marketing and transportation costs. Occasionally (although still rarely), it was profitable for producers in the Center-West to sell their soybeans for the guaranteed price and let the Government pay for transporting the soybeans to market. A similar effect was obtained under a national uniform energy price for diesel fuels. Farmers in the South faced an above market official price for fuel, while producers in the interior usually found the official price to be below local market prices.

**National System of Rural Credit.** In 1965, a National System of Rural Credit was created with the following goals: accelerate adoption of new technology, stimulate capital formation, improve the economic position of small and medium size farmers, and increase production of agricultural commodities destined for export markets to increase foreign exchange.

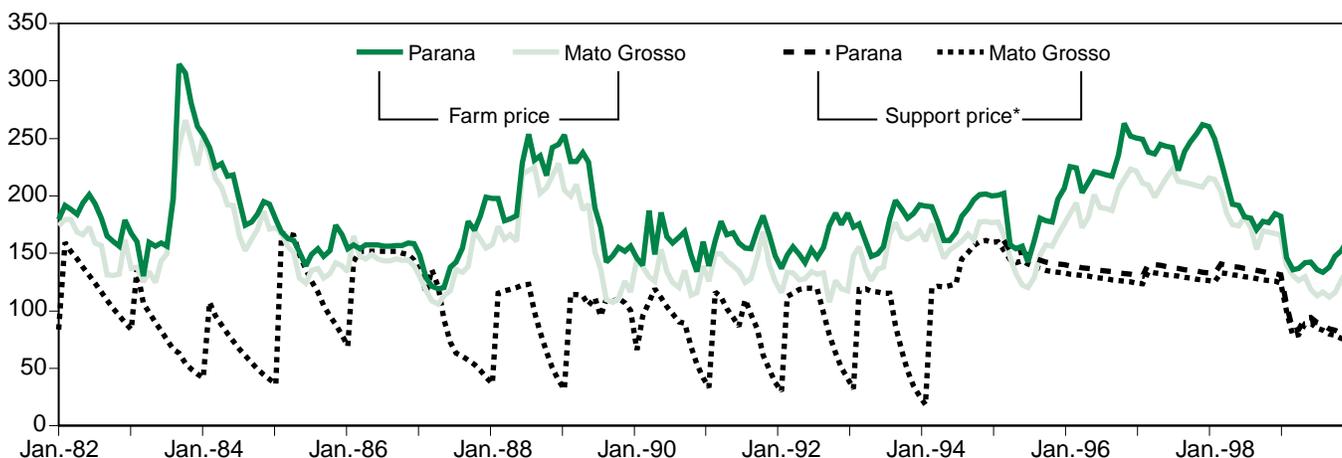
During the 1970s and 1980s, enormous amounts of government agricultural credit were disbursed through separate production, investment, and marketing credit programs. About 85 percent of total credit to agricultural producers during this period was provided by the official credit system because private sector credit was not very developed.

The interest rate on government credit was heavily subsidized. Interest rates were usually set at a fixed, nominally low rate. In a highly inflationary economy, this resulted in an average real interest rate of -12.5 percent between 1970 and 1990 (fig. D-2). The interest rate subsidy to soybean producers is estimated to have averaged nearly \$200 million per year during this period, peaking in the late 1970s and early 1980s (Warnken, 1999).

Figure D-1

**Soybean farm prices in Parana and Mato Grosso rarely fall below the government support price**

\$/metric ton



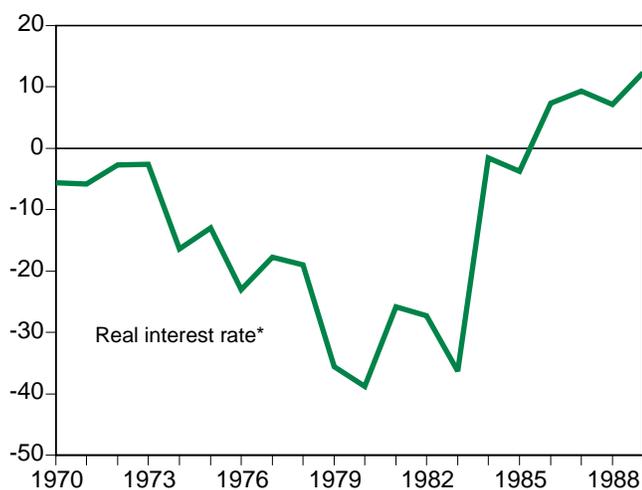
\*Starting in February 1995, separate monthly price guarantees were established for Mato Grosso and Parana.

Source: Monthly prices; CONAB (for minimum price support); Fundacao Getulio Vargas (for farm price).

Figure D-2

**Fixed nominal interest rates on government soybean production credit and high inflation combined to produce negative real interest rates**

Percent



\*Official interest charge minus nominal inflation rate.

Source: Fogarty (1991).

Production credit was closely linked to the national support prices. Although the support price is below market prices in most years, it affects soybean production since the availability of credit for current production expenses is tied to the minimum price for soybeans. Prior to 1978, medium- and large-sized soybean producers could finance up to 60 percent of the value of their expected revenue (support price

times expected yield). In 1978, large producers were limited to no more than 48 percent of the projected revenue.

Between 1970 and 1990, the GOB distributed nearly \$28 billion in official credit to soybean producers, mostly (60 percent) in the form of production credit (fig. D-3). In 1975 alone, the value of publicly disbursed agricultural credit exceeded the value of total agricultural production (Fogarty, 1993). By law, the subsidized credit could go only to landowners. As a result, production and marketing credit favored the large farms of Brazil's Center-West.

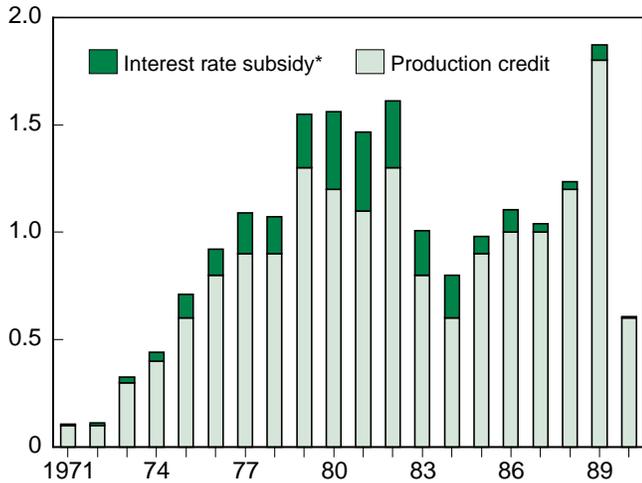
The GOB's credit program proved to be highly inflationary and, due to the fungibility of credit, there is some question about what share of disbursements were actually devoted to the agricultural sector. Substantial "slippage" likely occurred as many nonfarm sector investments offered higher returns. The credit program was eventually pared down in the late 1980s under pressure from the international donor community.

**Wheat Policy.** Starting in 1962, the Brazilian Government began an aggressive program of self-sufficiency in wheat via high support prices—nearly double world market prices, making wheat the only domestic crop for which the GOB tried to offset the effects of the overvalued exchange rate. Exceptions to trade barriers for importing equipment and other inputs were made for wheat. Also, the GOB furnished extensive credit to wheat producers (primarily in Rio Grande do Sul).

Figure D-3

**Brazil's government channeled billions of dollars of production credit to the soybean sector during the 1970s and 1980s**

Bil. U.S.\$



\*Implicit value of subsidy due to negative real interest rates on soybean production credit.

Source: Fogarty (1991).

Soybeans benefited by being planted as a second crop after wheat production. Sequentially growing the two crops on the same land increased the productivity of inputs and the input/output marketing systems. Eventually the wheat program proved expensive and inefficient, and was abandoned, but not before expanding soybean output. Furthermore, by stimulating surplus production of soybeans, markets and trade channels had been established, reinforcing the likelihood of continued soybean production.

**Coffee Eradication Program.** In the 1950s and 1960s, coffee was a preferred crop and received considerable government support (although export taxes and an overvalued exchange rate lowered producer incentives). However, recurring freezes in the 1960s stimulated a coffee eradication program in western Sao Paulo and Parana. The primary crop planted on the cleared coffee land was soybeans. Thus, the coffee eradication program resulted in expansion of soybean area in the South.

**Fuel Alcohol (ProAlcool) Program.** During the 1970s and 1980s, sugar cane production received considerable GOB support under a national program to promote domestic production of fuel alcohol. Under the program, some of the most productive agricultural land in Parana and Sao Paulo was diverted to sugar cane

production, reinforcing soybean production's westward expansion into the Center-West.

**Other Influential Programs.** Several policies aimed at territorial integrity had the indirect effect of promoting soybean expansion into the Center-West. The nation's capital was moved from Rio de Janeiro to interior Brasilia in 1960. The Government invested in the construction of the Trans-Amazon highway. A government-financed migration program was established to encourage landless or near-landless agricultural workers from the South to move to the Center-West to obtain free tracts of government land.

In the 1970s, the GOB initiated an "Export Diversification Push," accompanied by a series of currency devaluations. At the same time, the GOB strengthened export controls and quotas on raw agricultural products to ensure adequate supplies of food and raw materials for consumers and domestic industry. However, the GOB was also interested in using agriculture to generate foreign exchange and to help pay down the country's international debt. Consequently, unprocessed agricultural exports were taxed, while export subsidies were given to processed exports. As a result, domestic commodity prices fell well below world market levels, stifling producer incentives.

Quantitative export restrictions on certain food products (e.g., soyoil) also helped to enforce domestic consumer price ceilings and to ensure a positive crushing margin for oilseed processors. Varying differential export taxes and subsidies on soybeans, soymeal, and soyoil have often been used to maintain incentives supportive of the domestic crushing sector.

***International Events Propel Global Oilseed Demand***

In the early 1970s Brazil's soybean sector was aided by international events. A surge in world demand from growing populations and incomes, combined with a series of weather-related crop shortfalls in major grain and oilseed producing countries and a drawdown of global stocks, generated historically high international market prices for most major commodities.

The crises began with the failure of the Peruvian anchovy catch in 1972, which led to a precipitous decline in world fish meal production—then a major source of high-protein meal—and a very precarious international supply of high-protein feedstuffs. That

same year, the United States, the premier producer and exporter of soybeans and products, suffered a weather-damaged soybean harvest just as its exports of soybeans and soymeal were increasing rapidly. Despite sharply higher prices, U.S. exports were bolstered by a devaluation of the dollar in early 1973, which partially offset the impact of high prices on foreign buyers.

International soybean prices hit their historic peak in June 1973 at \$393 per metric ton. Concerns about global food shortages and vulnerability to weather shocks were complicated by skyrocketing petroleum prices and fears of global resource depletion. Unfortunately, the U.S. policy response to domestic price runups and diminishing supplies had the effect of worsening the global supply deficit.

In 1973, the U.S. imposed an export embargo on soybeans, cottonseed, and their products, in response to rapid increases in domestic oilseed prices. When the embargo was announced in June 1973, U.S. farm prices of soybeans had hit a record \$10 per bushel—triple the harvest-time low of the previous fall—reflecting unprecedented demand. The embargo was replaced by export licenses and was extended further to cover most of the oilseed complex. As a result, U.S. prices fell, but international prices rose sharply during the few weeks that U.S. export controls were in place. The real damage to U.S. producers was not the temporary lower domestic prices, but the loss of confidence in the United States as a reliable supplier of agricultural products on the part of one of the United States' most important agricultural markets—Japan.

Following the embargo, Japan began looking for alternative sources for soybeans and products. Brazil provided the perfect opportunity and Japan began investing in Brazil's emerging soybean industry.

### ***Soybean Area Heads West***

Brazil's farmers rapidly expanded their production of soybeans and other field crops in response to the strong international market signals of the early 1970s. During 1970-1990, Brazil's soybean production grew by over 10 percent per year, driven predominantly by area expansion (8.3 percent per year). Harvested soybean area increased five-fold, jumping from an average of under 2 million hectares in 1969-71 to over 10 million hectares in 1989-91 (table D-1). In the South, curtailment of the national wheat program, reduced coffee area, and improving relative returns for soybeans contributed to a shift into soybeans

throughout the 1970s. Meanwhile, government policies and programs designed to facilitate soybean expansion into the Center-West brought new area under cultivation throughout the 1970s and 1980s (fig. D-4).

Brazil's soybean yields grew nearly 2 percent annually during the 1970s and 1980s, further propelling output growth. However, at 1.8 tons per hectare by 1989-91, average yields still lagged U.S. and Argentine yields by about 20 percent. Policy-imposed barriers to acquisition of international technology and inputs, coupled with high domestic transportation costs, appear to have constrained yield growth, particularly on the acidic tropical soils of Brazil's Center-West. Yet, improving access to cheap, abundant land continued to fuel the region's expansion of commercial agricultural production.

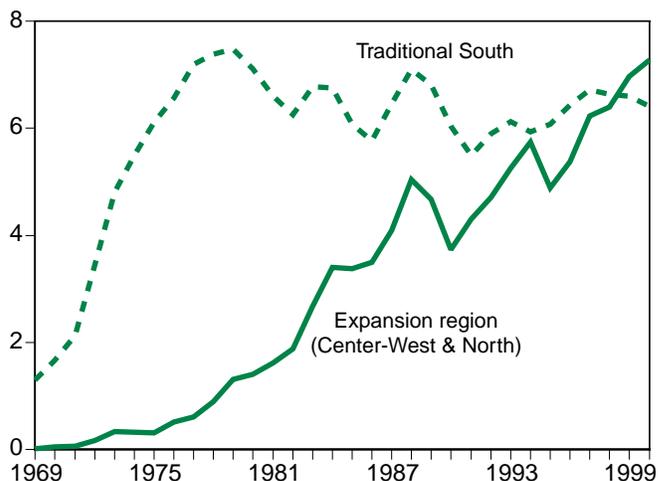
It was not until 1978, after government programs encouraging soybean expansion into Brazil's interior States had been in place for more than a decade, that the Center-West's soybean sector accounted for as much as 10 percent of either national harvested area or production. However, once underway, the Center-West's soybean industry has accounted for an ever-increasing share of national production (fig. D-5).

By 1989-91, 41 percent of national soybean area and 46 percent of national production were located outside

Figure D-4

### **Brazil's soybean area has expanded onto the *cerrado* soils of interior States, but has stagnated in the traditional South**

Mil. hectares (harvested soybean area)



Traditional region=Rio Grande do Sul, Santa Catarina, Sao Paulo, and Parana; Expansion region=Mato Grosso, Mato Grosso do Sul, Minas Gerais, and others.

Source: USDA; July 2001.

**Table D-1—Shifts in regional soybean production in Brazil**

Period averages	Brazil	South-Southeast <sup>1</sup>	Center-West <sup>2</sup>	North-Northeast <sup>3</sup>
<i>Million hectares</i>				
<b>Harvested area</b>				
1970-74	3.698	3.510	0.157	0.031
1975-79	7.678	6.946	0.598	0.134
1980-84	8.890	6.683	1.858	0.349
1985-89	10.594	6.445	3.309	0.840
1990-94	10.639	5.869	3.701	1.069
1995-99	12.370	6.472	4.575	1.323
<i>Million metric tons</i>				
<b>Production</b>				
1970-74	5.616	5.347	0.216	0.053
1975-79	11.735	10.603	0.947	0.186
1980-84	15.321	11.284	3.404	0.633
1985-89	18.672	10.801	6.389	1.482
1990-94	21.630	11.356	8.132	2.141
1995-99	29.090	14.189	11.802	3.099
<i>Metric tons/hectare</i>				
<b>Yield</b>				
1970-74	1.460	1.464	1.352	1.532
1975-79	1.539	1.538	1.569	1.346
1980-84	1.713	1.687	1.814	1.798
1985-89	1.756	1.669	1.931	1.749
1990-94	2.018	1.935	2.188	1.994
1995-99	2.382	2.191	2.565	2.347

<sup>1</sup>South-Southeast = Rio Grande do Sul, Santa Catarina, Parana, Sao Paulo, Minas Gerais.

<sup>2</sup>Center-West = Mato Grosso, Mato Grosso do Sul, Goias, Federal District.

<sup>3</sup>North-Northeast = Rondonia, Tocantins, Maranhao, Piaui, Bahia, and others.

Source: CONAB and unofficial USDA data.

of the South. Higher yields in the Center-West reflected greater economies of scale in production due to significantly larger farm sizes, more modern cultivation practices, and whenever feasible, greater use of chemical inputs. In contrast, land in the South has become increasingly parcelized, which has inhibited adoption of mechanization, and is also subject to significantly greater variation in rainfall, thereby increasing yield and production risk (fig. D-6).

### ***Downward Spiraling Economy Builds Up to Reform***

Brazil's macroeconomic environment provided an unlikely backdrop for the soybean sector's rise to preeminence. By 1979, Brazil's foreign debt exceeded \$100 billion, equivalent to 28 percent of national GDP. In the early 1980s, rising interest rates created an escalating cycle of new borrowing to pay current interest payments, and by 1982, Brazil could no longer service its debt. Brazil's external debt, relative to GDP, peaked at over 33 percent.

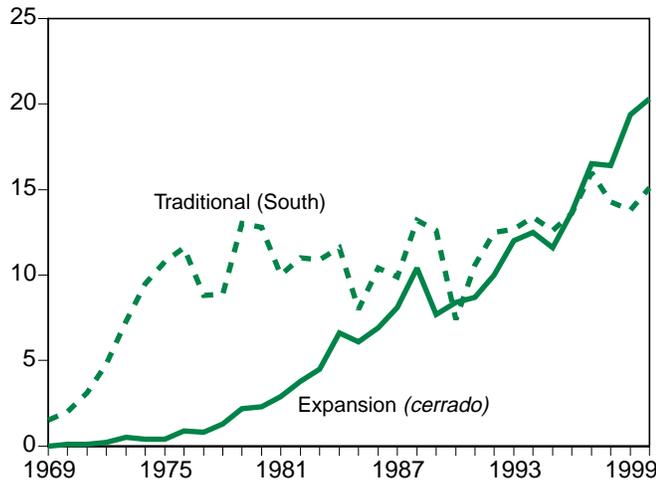
In the mid-1980s through the mid-1990s, Brazil experienced dramatic variations in annual inflation rates, a ballooning external debt, and years of sluggish or negative economic growth. The annual inflation rate soared upward, exceeding 100 percent by 1980 and 200 percent in 1983, before oscillating up to hyperinflation with annual rates over 1,000 percent (fig. D-7). This inflationary phenomenon explains, in large part, why Brazil's soybean economy evolved a market system whereby inputs and outputs are priced either in U.S. dollars or in terms of "bags of soybeans."

Brazil spent most of the 1980s adjusting to debt-related problems, escalating inflation, and the transition to a democratic government. Trade restrictions were once again tightened. Government spending, including agricultural support, was cut. Wages, prices, and interest rates on agricultural credit were indexed to the general inflation rate, and the import-competing and export sectors were promoted to increase foreign exchange earnings for debt reduction.

Figure D-5

**Continued expansion onto high-yield *cerrado* soils is the driving force behind Brazil's rapidly growing soybean output**

Soybean production (mil. metric tons)



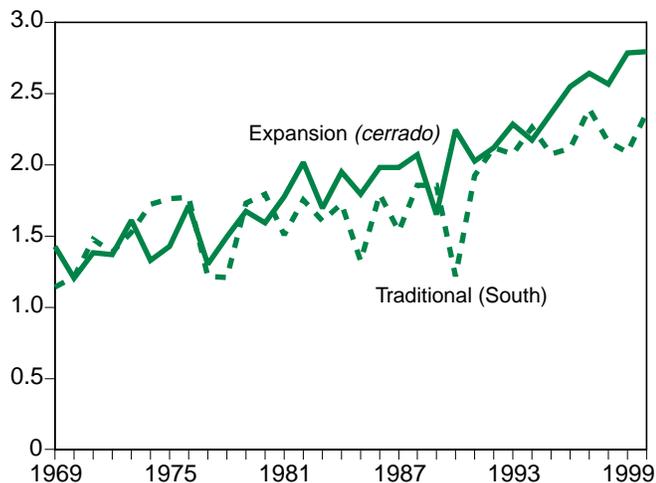
Traditional region=Rio Grande do Sul, Santa Catarina, Sao Paulo, and Parana; Expansion region=Mato Grosso, Mato Grosso do Sul, Minas Gerais, and others.

Source: USDA; July 2001.

Figure D-6

**Soybean yields are rising fastest in the "expansion areas" on *cerrado* soils**

Soybean yield (metric tons/hectare)



Traditional region=Rio Grande do Sul, Santa Catarina, Sao Paulo, and Parana; Expansion region=Mato Grosso, Mato Grosso do Sul, Minas Gerais, and others.

Source: USDA; July 2001.

In 1985, military rule was replaced by a populist democratic coalition. The new government introduced several reforms favoring small producers—i.e., producers of food crops such as corn and dry beans—and consumers over producers of export-oriented crops. The nation's research and extension programs were also reorganized to focus on food crops instead of soybeans.

Despite this reorientation, Brazil's soybean production hit a then-record 23.6 million tons in 1988 after 4 years of relatively strong domestic commodity prices. Exports of soybeans and soymeal also hit records of 5.1 and 9.6 million tons (approximately 17 million soybean-equivalent tons in total). However, production declined by 33 percent in the following 2 years (to 15.8 million tons in 1990) due to low domestic prices and poor growing conditions. Nevertheless, Brazil remained an important exporter of soybeans and products—average soybean exports of 3.2 million tons in 1989-91 garnered a 12-percent share of world trade; average soyoil and soymeal exports of 0.7 and 8.2 million tons earned 17 and 31-percent shares of world trade. However, relatively higher export taxes on whole soybeans, compared with soyoil and soymeal, continued to favor domestic processors and the export of soybean products.

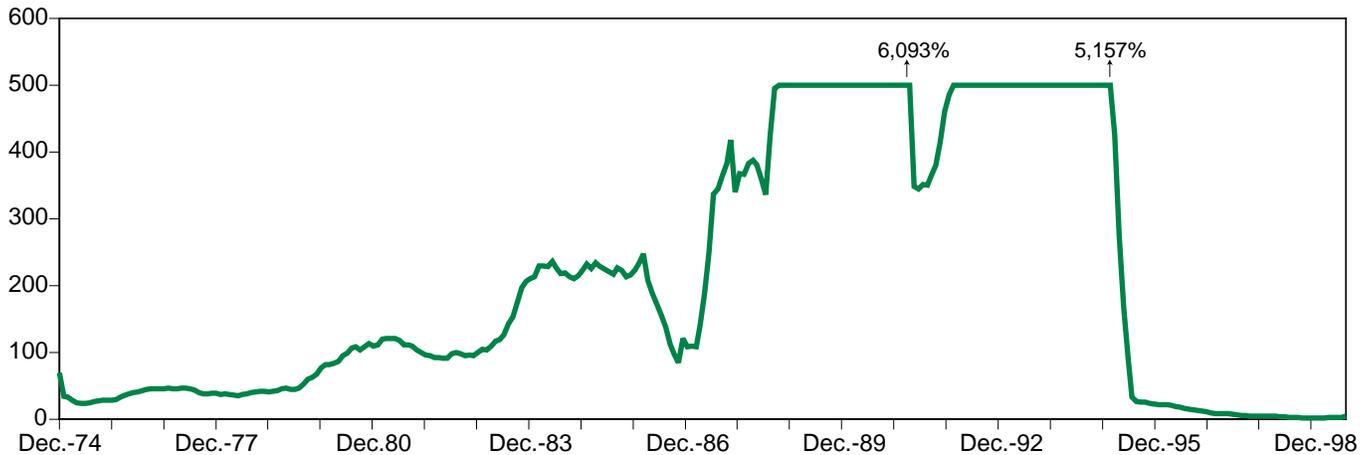
By mid-1989, Brazil had an unserviceable foreign debt of \$120 billion, and its economy entered the 1990s with declining real growth and runaway inflation. In addition, the economy remained highly regulated, inward-looking, and protected by substantial trade and investment barriers. Import tariffs averaged nearly 45 percent and the currency was severely overvalued (fig. D-8). In short, Brazil's economy was not investment friendly.

In March 1990, the Collor government assumed power and immediately launched reforms designed to modernize and reinvigorate the economy. To stabilize prices, government spending was cut, thousands of government workers were laid off, and the GOB froze two-thirds of the country's financial assets for 18 months. In an effort to deregulate the economy, some state-owned enterprises were privatized and a state monopoly on wheat marketing and trade was eliminated. The economy was opened to increased foreign competition by liberalizing trade and investment policies. The foreign exchange market was converted to a floating exchange rate. The import market was deregulated, and many nontariff trade barriers, including trade licensing, were removed.

Figure D-7

**Brazil experienced hyperinflation from the mid-1980s to the mid-1990s\***

Rate of inflation (%)

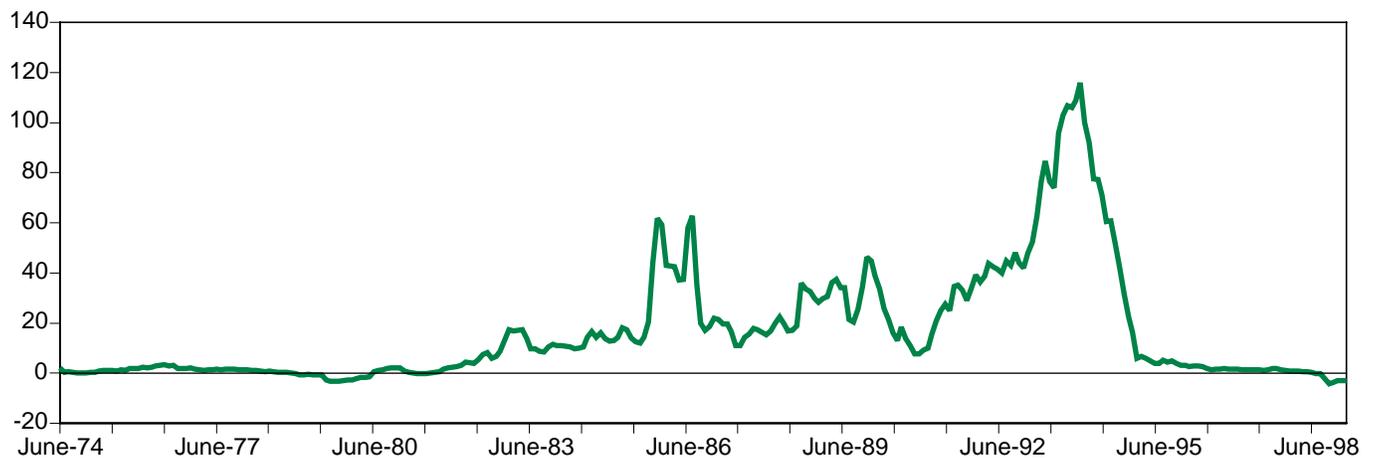


\*Monthly observed annual rate of inflation based on consumer price index data. Capped at 500 percent to improve presentation.  
Source: IFS/IMF.

Figure D-8

**Prior to the 1994 Real Plan, Brazil's exchange rate was often highly overvalued\***

Percent overvaluation



\*Rate of change of Official Exchange rate minus rate of change in a purchase power parity index comparing Brazil and U.S.; 11-month moving averages of both series used to smooth data.  
Source: IFS/IMF data; authors' calculations.

In an attempt to spur agricultural investment, the GOB instituted new farm income taxes to be assessed only on profits not reinvested in the sector. In contrast, taxes on export profits were raised from 18 to 30 percent. By 1991, import tariffs had declined to about half of 1989 levels, averaging about 21 percent. In 1992, import tariffs were reduced further.

**Cardoso Launches Brazil's "Real Plan"**

By June 1994, the annual inflation rate was again over 5,000 percent and once more undermined economic stability. Finance minister Cardoso launched the first phase of his stabilization plan known as the *Real Plan*. Effective July 1, 1994, the plan introduced a new currency, the real (*R\$*), which was pegged to the U.S.

dollar using a “mini-band” mechanism that allowed only small daily changes in the value of the currency. This policy change improved market confidence. The exchange rate policy, along with tight monetary policy, began to dramatically lower inflation.

In 1995, the newly elected President Cardoso called for sweeping market-oriented reform, including deregulation of the private sector, expanded privatization of state-owned enterprises, fiscal reform, and elimination of barriers to increased foreign investment.

The psychological “mind set” of reform was reinforced in January 1995, with the almost total elimination of trade restrictions within the MERCOSUR trade zone encompassing Argentina, Brazil, Uruguay, and Paraguay.<sup>3</sup> Members now engage in trade with few duties between member states and a common set of external tariffs.

Since January 1997, Brazil’s annual inflation rate has been under 10 percent, the lowest in 30 years, and dipped below 5 percent in late 1998. Although inflation abated, Brazil’s agricultural sector remained heavily indebted, and high real interest rates sharply increased borrowing costs and, consequently, costs of production. However, limited access to public and private sector credit likely poses a greater constraint to the agricultural sector than indebtedness.

As the Government has reduced the availability of public credit in recent years, more credit has originated from private sources. Nevertheless, agricultural credit from all sources (public and private) averaged only \$7.6 billion between 1995 and 1998, compared to a yearly average of about \$8.3 billion in official credits alone between 1970 and 1990. In addition, by the end of the 1990s, the official credit system was mostly oriented toward small farmers, while larger farmers had to seek credit from private banks. However, credit remains costly and limited. Interest rates, once 25-30 percent in the late 1990s, still averaged nearly 18 percent in 2000.

### ***Intrastate Tax (ICMS) Distortions***

Since 1994, Brazil’s soybean industry has operated with far less direct and indirect government interven-

<sup>3</sup> MERCOSUR is a Spanish acronym for “Common Market of the South.” The Portuguese acronym is MERCOSUL. MERCOSUR is actually a customs union. While free trade reigns within the union, the pact is often very protectionist toward nonmember trade.

tion. However, the ICMS (*Imposto sobre Circulacao de Mercadorias e Servicos*), a value-added tax imposed on the movement of all goods (including soybeans and products) remains. ICMS tax rates are set by the GOB at nationally uniform rates (ranging from 5 to 13 percent) that vary depending on the product and whether it is sold within the State, to another State, or exported. Since the taxes are collected by State governments, the cost has tended to vary by State and by product due to manipulation of payment terms, interest charges, and other fees.

In general, the ICMS tax system raises the cost of moving agricultural commodities through market channels and ultimately reduces farmgate prices and incentives to produce. For some commodities, the rate also varies depending on the degree of processing, thereby introducing other market distortions. For example, until 1996, soybeans moving to export were assessed an ICMS tax of 13 percent, but soybean meal and oil exports were charged just 11 and 8.5 percent. This inequity encouraged domestic processing at the expense of whole bean exports.

Because ICMS taxes represent a principal source of state revenue, the GOB has been unable to remove them but has attempted to mitigate their distortive effects. Perhaps the most significant policy development for Brazilian soybean farmers since implementation of the Real Plan was national Law 87, enacted in September 1996, which exempted foreign-bound exports of raw materials and “semi-manufactured” products from the ICMS taxes. This action created new incentives to export agricultural products, since interstate movements of commodities destined for domestic consumption remained subject to this tax. Since the ICMS export tax had imposed higher taxes for less processed goods, its removal had the largest impact on whole soybean exports. In the 3 years prior to elimination of the ICMS export tax—1992 to 1995—Brazilian soybean exports averaged 4.2 million tons. In the 4 years following its removal—1996 to 1999—average soybean exports more than doubled to 9.6 million tons per year.

The ICMS tax continues to cause distortions in the domestic crushing industry. Crushers must pay the ICMS when they buy soybeans from other States, then recover (at a later date) the ICMS paid on soybeans if the resulting product is exported. However, the ICMS recovery system does not appear to be functioning well. For crushers who source their raw material

across a State border (but within Brazil), this implies an accumulation of tax rebates until they actually export the final product. To avoid this cash-flow constraint, crushers compete for raw material within their own State, which may subsequently increase local prices if crush capacity within a State is large relative to supply. Since their “squeezed” margin does not allow them to pay the same price for the soybean as traders on the international market, small Brazilian crushers are disadvantaged. Large multinational firms that both crush and trade are less affected.

A peculiarity of Brazil’s ICMS tax system has been the encouragement of Brazilian investments in soybean farms in nearby Paraguay and Bolivia. Soybeans imported into Brazil are not charged the ICMS if the products are re-exported. This has encouraged the importation of Paraguayan and Bolivian soybeans to Brazilian plants. In years of low production, drawback provisions have even encouraged soybean imports from the United States, including nearly 800,000 metric tons in (calendar year) 1997.

### ***Input Use Grows Rapidly During the Real Plan***

In the early 1990s, fertilizer, pesticide, and agricultural machinery use in Brazil lagged well behind use in the United States, partially explaining lower corn, wheat, and to a lesser extent, soybean yields. Brazil’s national average application rate of all fertilizers had peaked in 1980 at 76 kg per hectare when significant amounts were being applied to the sugar cane crop. By 1990,

the rate had fallen to 55 kg (compared with 187 kg in the United States)—due in large part to lower usage rates for sugar cane—but recently surpassed 1980 levels. For soybeans alone, application rates have shown steady growth over the last several decades.

Following the reduction and/or elimination of import barriers on agricultural inputs during the 1990s, imports of agricultural inputs and their use increased dramatically (fig. D-9). Total fertilizer imports (nitrogen, phosphate, and potash) jumped from an average of about 1.4 million tons in 1989-91 to a record 3.5 million tons in 1997. Nitrogen imports more than tripled to 686,000 tons. Phosphate imports increased almost seven-fold to 713,000 tons, and potash imports jumped by 87 percent to about 2.1 million tons. Phosphate and potash are important for soybean production in the *cerrado*.

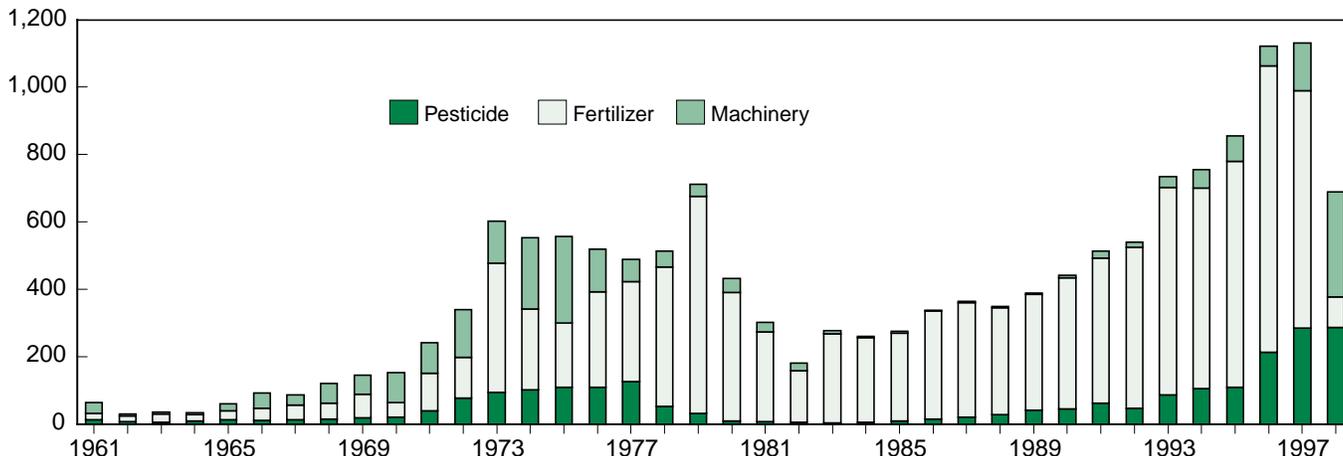
Imports contributed to an increase in total fertilizer consumption from about 3.3 million tons yearly during 1989-91 to a record 5.7 million tons in 1998. By 1998, Brazil’s total fertilizer use of 103 kg/hectare, although significantly higher, still lagged the United States (196 kg/hectare).

Total pesticide imports also rose sharply from an average value of \$38.4 million in 1989-91 to almost \$285 million in 1998. Imports of agricultural machinery (i.e., tractors, harvesters, threshers, and milk machines) jumped from an average of \$10 million in 1989-91 to slightly over \$200 million in 1998. Current national average usage rates likely

Figure D-9

### **Brazil’s imports of agricultural inputs accelerated in the mid-1990s following economic reforms**

\$ mil.



Source: FAO, FAOSTATS.

understate input growth in the Center-West, where larger farm sizes and less fertile soils encourage higher input application rates than in the South.

Despite the inflow of foreign machinery, postharvest losses were still excessive in the late 1990s. A 1998 EMBRAPA study found that Brazilian soybean growers left an average of 102 kilograms of soybeans per hectare (or 1.3 million tons) on the ground from the 1996/97 crop due to faulty operation or maintenance of soybean harvesters. Another 8 percent of production was lost due to breakage or crushing of the grains during harvest.

Spurred by policy changes, Brazil's soybean production and exports accelerated during the latter part of the 1990s on the strength of both area and yield growth (averaging 2.9 and 3.9 percent annually during the 1990s). Brazil's soybean exports rose to an average 10.3 million tons in 1999-2001, capturing over a quarter of world market share. Brazil's soy product exports also increased during the 1990s, particularly soybean exports which doubled to over 1.3 million tons. Soybean exports rose more modestly (about 20 percent) to 10.2 million tons, but have also fed value-added poultry exports, which nearly tripled between 1990 and 2000 to 950,000 tons.

### ***Brazil's Soybean Processing Industry In Transition***

Favored by fiscal incentives and highly subsidized rural investment credit, Brazil's soybean crushing sector and agricultural input sector both underwent rapid growth during the 1970s and 1980s. Large soybean-only crushers replaced small multiple-product crushers, and industrial technologies shifted from inefficient mechanical presses to state-of-the-art hexane extraction. This occurred with the help of government subsidies from the National Economic and Social Development Bank (BNDES). However, capacity was built up with little regard for cost considerations or location. As a result, much capacity has become out-of-date and inefficient (Vieira and Williams, 1996).

The removal of the ICMS export tax on whole soybeans in 1996 exacerbated the problem for inefficient crushers. Several crushing plants in Brazil closed during the 1990s as the sector shifted to greater soybean exports at the expense of meal and oil exports. Brazil's crushing capacity fell from about 125,000 tons per 24-hour day in 1992 to 106,000 tons in 1999/2000 (J.J. Hinrichsen, 2000; Vieira and Williams, 1996). More than one-quarter of capacity

was unused in 1999/2000, compared with about 12 percent in 1996/97. Smaller, less efficient crushers have dropped out. In 1999/2000, over 60 percent of the soybeans were processed in plants processing over 1,500 tons per day, compared with 50 percent in 1993. Plants processing less than 600 tons per day were less than 10 percent of the total capacity in 1999/2000.

Rio Grande do Sul and Parana in the South and Sao Paulo in the Southeast house more than two-thirds of Brazil's processing capacity, while the Center-West's Mato Grosso and Mato Grosso do Sul have only 13 percent of the total (as of 2000). However, the industry is slowly following soybean production to the Center-West and North to create new integrated centers of grain and meat production.

Since the reforms of the early 1990s, the crushing industry in Brazil has become concentrated and denationalized, with major U.S. and EU players moving in or increasing their market share. Exchange rate policy changes have accelerated this consolidation. Currently, the five largest companies—Bunge, Cargill, Coimbra (Louis Dreyfus), ADM, and Granoleo—own about 60 percent of total crushing capacity. The presence of multinationals in the major food processing subsectors may mean more efficient use of facilities across countries.

### ***Brazil's Exports Benefit From Currency Depreciation***

Under the reforms of the early 1990s, the Brazilian real—much like the Argentine peso—was also closely linked to the U.S. dollar, but under a crawling peg with a mini-band mechanism. Through much of the 1990s, this currency linkage held. Unfortunately, a rapidly strengthening U.S. dollar resulted in inflated real-priced commodities in international markets. By late 1998, the appreciating U.S. dollar and fears of a “contagion effect” following the Russian financial crisis plagued the real. In January 1999, Brazil's Government delinked the real from the U.S. dollar and allowed it to float freely. The real responded by depreciating sharply—32 percent in the first month—against a strengthening dollar.

The currency depreciation benefited Brazil's export sector by lowering the price of its export products in world markets. For Brazil's soybean producers, the depreciation raised farm prices in local currency terms and continued to boost soybean plantings despite declining world prices. Since its initial plunge in January 1999, the value of the real has continued to decline

against the dollar, and now carries only half the value it had prior to the devaluation. A countervailing effect came from increased costs of dollar-denominated fertilizer and herbicide imports, but producers and input suppliers have sidestepped this problem by pricing most inputs in terms of bags of soybeans. The direction of Brazil's exchange rate will continue to be an important determinant of its export competitiveness.

Many additional costs and policy distortions—often referred to as “the Brazil Cost”—are still in effect in Brazil. These include an inefficient infrastructure that raises marketing costs, high interest rates that discourage investment, and state-level taxes (ICMS) on the movement of goods and services. Nevertheless, the Brazilian economy's performance continues to improve, with strong GDP growth in 2000, and a slight decline in the current account deficit and net public debt. A recent IMF report concluded that Brazil is better placed than in the early 1990s to withstand external economic shocks and that strong fiscal discipline should help put Brazil on a sustained trajectory of dynamic private sector-led growth (IMF, November 2000).

### Brazil's Infrastructure Development Holds the Key to Agriculture's Future

Brazil possesses a long coastline with several major seaports, yet nearly 80 percent of Brazil's agricultural exports, including soybeans and products, traditionally have been handled by the three principal southeastern ports of Santos, Rio Grande, and Paranagua (table D-2). From a logistical perspective, soybean production located within a small radius of these ports remains highly competitive with U.S. soybeans in European markets. However, as Brazilian production moves into the interior, the high cost of getting soybeans to market erodes competitiveness. Navigable waterways of the eastern portion of the Center-West all flow west and south, draining into the Parana-Paraguay River system (which runs through Argentina). The sole exception is the Sao Francisco River, which runs north through Minas Gerais, then east to the coast through Bahia (fig D-10). Only in the past few years have Amazon tributaries such as the Madeira undergone development as viable export waterways.

Under the reforms of the 1990s, Brazil's transportation strategy was to cut costs by privatizing the nation's inefficient railways, upgrading and improving existing waterways, and developing new

**Table D-2—Brazil's soybean and products exports by port, Feb. 1998 to Jan. 1999**

Port	Soybean		
	Soybean	meal	oil
1,000 metric tons			
<b>Atlantic ports</b>			
Paranagua	3,734	4,646	849
Rio Grande	1,641	2,184	416
Santos	1,897	1,214	4
Sao Francisco	31	1,636	124
Vitoria	489	863	0
Ilheus	431	151	0
Sao Luis	358	0	0
Others	31	165	13
<b>Amazon River</b>			
Itacoatiara	581	0	0
<b>Parana-Paraguay waterway</b>			
Caceres/Corumba	118	0	0
<b>Total</b>	<b>9,313</b>	<b>10,859</b>	<b>1,406</b>

Source: DECEX/Safras & Mercados.

Figure D-10

**Several projects designed to open the Amazon waterway as a conduit for agricultural products are underway**



Source: Economic Research Service, USDA.

transportation routes along the Amazon waterway. In the past decade, significant progress has been made towards achieving these goals and lowering transport and marketing costs. However, Brazil's internal marketing costs remain high despite substantial post-reform, private-sector investment in road, rail, and waterway infrastructure.

From 1983-97, the margin between the f.o.b. Rio Grande do Sul port prices and farm prices for soybeans in Mato Grosso averaged a fairly stable \$76 per metric ton. In 1998 and 1999, the margin declined to an average of about \$47 per ton, implying that, even if international prices are held constant, producer incentives are improving via lower marketing costs. Similar margins for the South, based on average farm prices in Parana, were \$52 per ton during 1983-97 and \$31 in 1998-99 (fig. D-11).

In early 1996, the GOB initiated the privatization of publicly held railroads, setting in motion the gradual upgrade of the country's rail infrastructure. Massive sales occurred under this program, including almost the entire stock of nonurban track—about 27,000 kilometers—as well as 1,800 locomotives and 40,000 railcars.

Several projects designed to ease transportation of Brazil's agricultural output to port facilities have recently been completed or are currently in progress. For example, the *Madeira-Amazon waterway*, which became operational in 1997, is Brazil's newest river transport system and is an important transportation improvement for soybean production in western Mato Grosso. This waterway facilitates the transport of soybeans grown in Mato Grosso to international markets via the Amazon River. Soybeans are trucked from central and western Mato Grosso to Porto Velho, Rondonia, then barged north down the Madeira River to the Amazon port of Itacoatiara, located over 1,000 kilometers upriver from the mouth of the Amazon. A floating elevator at Itacoatiara offloads barges and uploads Panamax-sized

oceangoing vessels. Nearly 1 million tons of soybeans were estimated to have been exported via this route in 1999/2000, about half of its estimated capacity (Burrack, 2001). Transportation costs along this route are estimated at about \$84 per metric ton from central Mato Grosso to Rotterdam (Verheijden and Reça; 1998), about \$24 per ton less than using overland truck routes via the port at Paranagua.

The *Tiete-Parana waterway* is also expected to reduce freight costs for soybeans grown in Mato Grosso do Sul. These soybeans travel first by highway to the Parana River, then barge upriver via the Tiete to a railway that reaches the seaport of Santos. The Tiete-Parana system is presently the most developed waterway in Brazil, including 13 dams, 10 locks, and more than 1,000 navigational buoys (Goldsby, 2000).

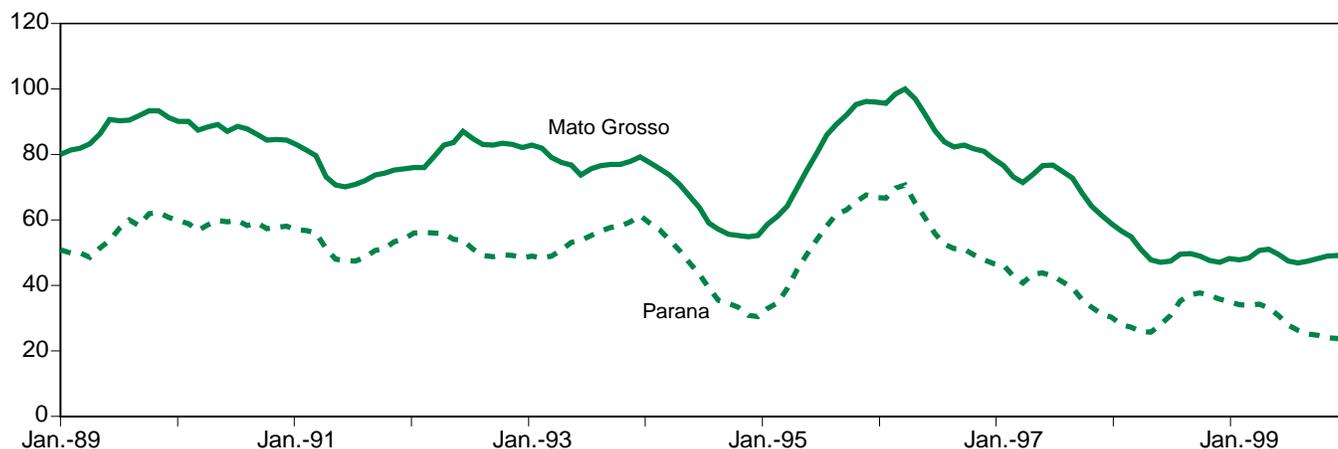
The *Parana-Paraguay waterway* conducts soybeans and other agricultural output from southern Mato Grosso do Sul to the Atlantic Ocean. Environmentalists have voiced concerns about the dredging of the Parana and Paraguay Rivers and its effects on the ecosystem of the Pantanal—an important natural wetlands area in southern Brazil about 2,700 kilometers from the Atlantic Ocean—due to potential water flow changes. These concerns may limit the extent of transportation improvements and subsequent cost reductions for soybeans and other commodities.

The *Ferronorte* railroad currently operates 780 95-ton railcars, with 50 locomotives, from the port of Santos through the State of Sao Paulo to Alto Araguaia in

Figure D-11

**Soybean f.o.b.-to-farm price differences are declining as infrastructure develops\***

U.S. \$/metric ton



\*12-month moving averages.

Source: farm prices, Getulio Vargas Foundation Brazil; F.O.B. prices (Rio Grande do Sul), Oil World.

southeastern Mato Grosso. By the end of 2002, it is scheduled to reach Rondonopolis, Mato Grosso, about 170 kilometers to the west. The *Ferronorte* will eventually be extended another 180 kilometers to Cuiaba, Mato Grosso. From there it will branch west to Porto Velho on the Madeira River and north to Santarem on the Amazon.

The *Novoeste* railroad extends from Santos to Corumba, Mato Grosso do Sul, near the border with Bolivia. Improvements under privatization of this railroad are expected to greatly facilitate access to export markets for producers in both Mato Grosso do Sul and southern Mato Grosso.

Plans to pave highway *BR163* from Cuiaba north through Mato Grosso to the Amazon port-city of Santarem, in the State of Para, will enable direct loading onto Panamax-sized oceangoing vessels. Mato Grosso officials are projecting cost savings of up to \$36 per ton (\$1 per bushel) for soybeans traveling from central Mato Grosso (Burrack, 2001). Although the 2002 completion date is overly optimistic, significant construction of agricultural processing facilities is underway along the proposed highway. For example, ADM has recently constructed a 10,000-ton-per-day oilseed crushing plant in Sorriso. The plant includes enormous storage facilities and rail loadout access in anticipation of the *Ferronorte* railroad's arrival.

Other infrastructure improvements targeting rail, roads, and waterways are either underway or in the planning stage. If realized, these improvements would enhance Brazil's competitiveness in international markets. In addition, they will increase domestic production incentives by permitting a larger share of international prices to reach the farm level, and will boost crop productivity by backhauling fertilizer and other farm inputs to these areas.

Fuller et al. (2000) evaluated the potential cost savings from transportation improvements in Brazil, including: (1) improvements in the upper *Parana-Paraguay* waterway and the deepening of ports in the lower Parana River, (2) the development of barge transportation on the Madeira River and its link to oceangoing transportation at Itacoatiara, (3) extension of the *Ferronorte* railroad from the port of Santos into the State of Mato Grosso, (4) privatization of the *Novoeste* railroad in Mato Grosso do Sul, and (5) improvement of highways linking Mato Grosso to Porto Velho on the Madeira River and Santarem on the Amazon River. The results indicate that:

- ◆ Improvements on the upper *Parana-Paraguay* waterway are projected to lower barge rates from Corumba in Mato Grosso do Sul to lower Parana ports in Argentina and Uruguay by \$8 a ton.
- ◆ Development of the barge-based Madeira-Amazon connection between western Mato Grosso and the port at Itacoatiara is projected to lower transport costs to export position by 20 percent (or \$11) from the current estimate of \$55 per ton by truck.
- ◆ Privatization of the *Ferronorte* and *Novoeste* railroads is projected to lower transportation costs by 40 percent (from \$30 to \$18/ton/1,000 kilometer) for agricultural produce out of Mato Grosso and Mato Grosso do Sul (Banco Interamericano de Desarrollo, 1996). Completion of the *Ferronorte* from the port of Santos to Rondonopolis is expected to further lower transport costs from that area.
- ◆ Improvements in these major transportation systems are expected to increase producer prices for soybeans in Mato Grosso do Sul, east Mato Grosso, and west Mato Grosso by about \$10, \$12, and \$20 per ton, respectively.

## Other Agricultural Sectors Are Vital to Soybean Prospects

This section presents developments in other agricultural sectors that have been integral to the evolution of Brazil's soybean sector. These include corn, wheat, rice, and cotton, as well as the livestock sector.

### *Brazil's Corn Sector on the Rise*

Brazil is a major corn producer, traditionally ranking third behind the United States and China in global production. Brazil's corn production has enjoyed steady growth during the past several decades. During 1999-2001, production averaged 36.2 million tons, up nearly 50 percent from average production during the 1980s. Despite such strong growth in corn output, production has barely kept pace with domestic demand. Nearly 20 percent of Brazil's corn production enters domestic food channels, with the remainder used as animal feed. During the 1990s, Brazil's huge domestic market (including rapidly growing poultry and pork industries) easily absorbed the entire crop and Brazil was a regular corn importer, mostly from Argentina. Annual imports averaged over 1 million tons during the decade, fluctuating from 0.4 million tons in 1995 to 1.8 million tons in 1997.

However, with record production of 41 million tons in 2000/01, Brazil was a net exporter (of 3.7 million tons) for the first time since 1981. Brazil's corn crop appears to be predominantly nonbiotech, which may have contributed to demand from some major corn importing countries seeking *Starlink*-free supplies. Exports have also been bolstered by the continued weakness of the "free-floating" real.

Brazil's recent corn export surge may be temporary—net exports in 2001/02 are projected to drop to 500,000 tons. Future production and export growth prospects will likely hinge on the development of commercially viable tropical corn varieties and infrastructure developments that could continue to open up the Center-West to corn production. Corn yields in Brazil's tropical zone are subject to greater production risk due to the humidity, short day length, and occasional dry spells (*veranicos*). This risk factor has prevented corn from expanding more rapidly into Brazil's interior territories despite strong domestic demand and often-favorable prices for corn relative to other major field crops (e.g., soybeans and cotton).

However, continued adaptations of domestic corn varieties to tropical conditions, along with rotational benefits, have contributed to expanded corn plantings. A corn-soybean rotation offers many of the same advantages to Center-West producers that U.S. Corn Belt growers benefit from—e.g., weed and disease control and nitrogen fixation. To date, Center-West producers have avoided significant soybean nematode and disease problems despite continuous soybean cultivation in many areas, but such diseases will likely develop with time, particularly under continuous cropping. In addition, current low nitrogen use appears to

offer plenty of room for improvements in corn yields from more intensive input applications.

Brazil's net-trade status will be closely linked to the development of the pork sector and the increasingly export-oriented poultry industry (and the income growth that is driving them). If Brazil's researchers continue to improve tropical corn varieties, corn could compete with soybeans and cotton for area in the Center-West. Brazil's Government recognizes the importance of an adequate corn supply to the development of its pork and poultry sectors. Nearly 90 percent of field trials granted by the GOB on about 800 biotech projects are devoted to improving varieties of tropical corn (Taylor, 2001).

About 40-percent of corn area is in the South, with the remainder split between the Center-West and the Northeast (table D-3). However, yields are significantly higher in the Center-West where large-scale mechanization is more suitable to corn production. Average corn yields in the Northeast are suppressed by a large share of low-yielding subsistence corn cultivation.

An important phenomenon with respect to Brazil's corn production is the growth of second-crop output. Since 1989, second-crop production expanded from less than 0.5 million tons to a record 5 million tons in 1997 as producers responded to the high international corn prices.

### *Brazil's Wheat Sector on the Decline*

Brazil is perennially among the world's leading importers of wheat due to limited domestic production and a large, predominantly urban population with a

**Table D-3—Regional corn production in Brazil**

Period averages	Brazil	South-Southeast	Center-West	North-Northeast
<i>Million hectares</i>				
<b>Harvested area</b>				
1990-94	13.56	6.17	2.86	3.22
1995-99	12.75	5.15	2.51	3.51
<i>Million metric tons</i>				
<b>Production</b>				
1990-94	30.94	16.92	8.18	1.87
1995-99	32.45	16.66	8.99	3.60
<i>Metric tons/hectare</i>				
<b>Yield</b>				
1990-94	2.28	2.76	2.86	0.55
1995-99	2.55	3.24	3.58	1.03

Source: CONAB and unofficial USDA data.

strong demand for wheat products. During the 1970s and 1980s, the Brazilian Government supported wheat production over other field crops. Policies kept wheat area abnormally high and suppressed wheat imports. Brazil's wheat acreage peaked at 3.8 million hectares in 1979, but the sector continued to receive support until reforms in the early 1990s. During 1986-90, wheat area averaged about 3.5 million hectares and production about 5.8 million tons.

Under the policy reforms of the early 1990s, wheat production supports were removed and resources quickly left the sector. Since 1992, wheat harvested area has remained below 2 million hectares. In 1999-2001, Brazil's wheat area and production averaged only 1.4 million harvested hectares and 2.4 million tons. Much of the wheat area shifted into other field crops, particularly soybeans. Meanwhile, wheat imports began to flood in, growing almost 9 percent per year during the 1990s (fig. D-12). Brazil's imports were estimated at 7.2 million tons in 2000/01. This level would place Brazil as the world's leading wheat importer—a position it is projected to maintain at least through 2010 under USDA's longrun baseline projections (USDA; 2001).

### ***Cotton Production Poised for Breakthrough in the Center-West***

Soybeans are not the only major field crop to benefit from the expansion of commercial agriculture onto Brazil's *cerrado* soils. The tropical conditions of a long growing season, high year-round solar radiation, abundant rainfall (averaging 5-8 inches per month

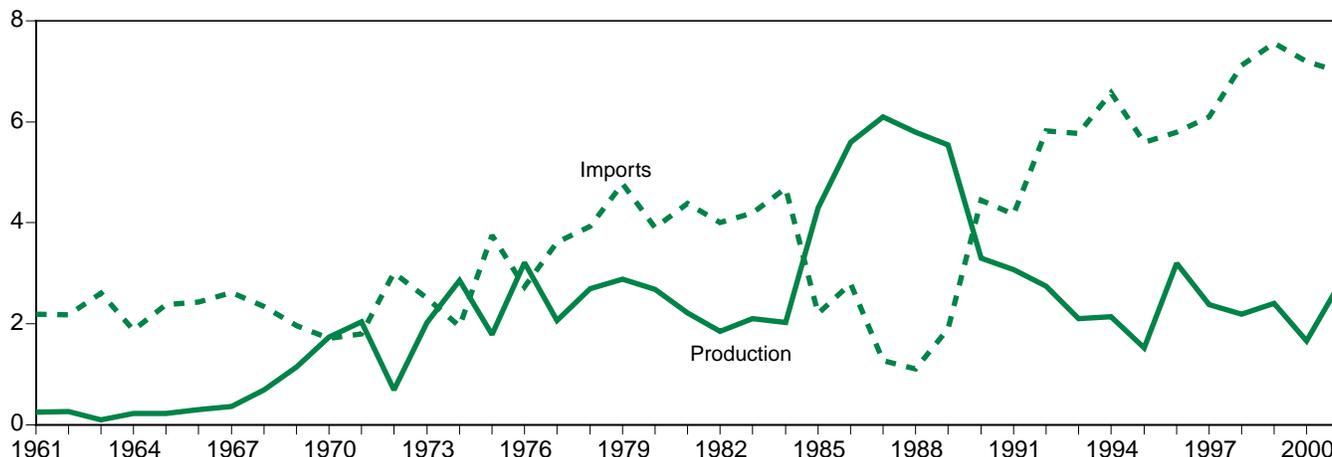
during the growing season), and year-round temperatures averaging in excess of 27°C (81°F) combine to offer tremendous production potential for cotton, a crop Brazil has regularly imported since the late 1980s. The occurrence of temporary droughts—*veranicos*—threatens yields only slightly given the nature of the cotton plant's development. Cotton yields are generally determined by the length of the growing season, with a preference for wetter conditions during the early stages of plant development and drier conditions during the latter stages. Thus, the distinct pattern of rainy and dry seasons in Brazil's Center-West, if coordinated with plantings, appears almost ideal for optimum yields.

EMBRAPA's 1990 study (Warnken, 1999) projected that new land development in the *cerrado* would most likely occur as large-scale mechanized agriculture based on a rotation system of improved pasture, grains, and oilseeds with some perennial crops (mostly coffee) for enterprise diversification. At the time of the study, the Brazilian cotton industry was on the decline, with little prospect for the expansion into the Center-West that is currently underway. Brazil's total cotton harvested area had fallen from 2.4 million hectares in 1988 to 0.7 million hectares in 1996, with most of the reduction occurring in the South and Northeast. However, varietal improvements in the late 1990s and increasing mechanization appear to have opened the Center-West to economical cotton production. That region has seen its cotton harvested area climb from 557,000 hectares in 1996 to 853,000 hectares in 2000 and now accounts for 86 percent of Brazil's harvested cotton area.

Figure D-12

### **Brazilian wheat imports have accelerated since the late 1980s in response to declining production**

Mil. metric tons



Source: USDA; Aug. 10, 2001.

Production data for the 1999 and 2000 crop years bear witness to the Center-West's excellent growing conditions. Average cotton yields exceed 1 metric ton of lint cotton per hectare for Mato Grosso do Sul and Goias, while yields in Mato Grosso are estimated to surpass 1.285 tons per hectare. This compares with U.S. national average yields of about 0.7 ton per hectare. Such high yields are atypical of upland, rainfed cotton production, but instead typify irrigated production in a Mediterranean-type setting.

Cotton producer incentives in Mato Grosso received an added boost in 2000 when the State government passed a special tax break for cotton. Under the law, 75 percent of ICMS taxes for cotton are to be refunded, 60 percent to producers and 15 percent for research on cotton. Proposals for similar legislation are pending in Bahia and Maranhao.

### ***Rice Expected To Remain an Important Food Crop***

Rice has been an important crop in the Center-West since large-scale commercial agriculture first arrived, partly because it fits well into the crop cycle associated with clearing virgin scrubland. Initially, after the scrub brush has been cleared and burned, the land is planted to a cover crop and some cattle are run on it. Prior to the take off of soybean production in Brazil, the most widespread and traditional use of cleared and fertilized savanna land in the Center-West was for pasture. Rangeland still remains the primary first use of newly converted scrubland. However, as infrastructure development brings feeder roads into the area, commercial field crop activity becomes viable.

Rice is traditionally the first row crop to follow conversion from rangeland. Because rice grains sit high on their stalks at harvest, they allow mechanical harvesting above much of the stubble that remained in

the field after initial clearing. After a year or two of rice cultivation, soybean production follows. As a result, total rice area on *cerrado* soils is linked to land expansion activities, although some rice may continue to be grown following the introduction of soybeans.

In general, Brazil's total rice area has been declining since the late 1970s falling from a 1979 peak of 6.5 million hectares (harvested) to only 3.3 million in 2000. Rice is likely to remain secondary to soybeans and corn, but it should remain an important food crop and a standby in crop rotations.

### ***Livestock Populations and Meat Production Grow Rapidly in Brazil***

Livestock in tropical Brazil are primarily beef and some dairy cattle, although sheep and goats also consume significant forage in this area. Enormous tracts of permanent pastureland (estimated at 185 million hectares) support Brazil's animal populations. Brazil has the world's largest commercial cattle herds. Average annual cattle inventories were estimated at 163.6 million head during 1998-2000. Unlike Argentina, Brazil's cattle population has been steadily increasing over the past three decades (table D-4). Like Argentina, most beef production is grass-fed. Brazil is also an important exporter of beef. However, foot-and-mouth disease (FMD) is endemic to most of Brazil's cattle herd (although a few States have obtained FMD-free status), so most of Brazil's beef exports are destined for lower-priced processing markets in Europe and North America.

Brazil's large dairy herds, estimated at 28.8 million head in 2000, also depend heavily on grazing and forage. However, a rapidly expanding poultry sector and a significant hog population are steadily increasing the demand for feed grains.

**Table D-4—Livestock populations and meat production in Brazil**

Period	Population				Meat production			
	Cattle	Pigs	Sheep	Goats	Beef & veal	Pork	Mutton & lamb	Poultry
	----- Million head -----				----- 1,000 metric tons -----			
1968-70	73.0	30.2	17.5	5.7	1,789	734	35	334
1978-80	111.7	34.5	17.9	8.0	2,690	910	28	1,131
1988-90	143.6	32.9	20.0	11.6	4,130	1,057	76	2,189
1998-2000	163.6	27.4	18.3	12.6	6,146	1,736	88	5,560

Source: FAOSTATS, FAO.

# Soybean Production Costs and Export Competitiveness in the United States, Brazil, and Argentina

## Introduction

Competitiveness in commodity markets reflects the influence of many different factors. These include relative resource endowments and agro-climatic conditions, but also the impact of macroeconomic policies (affecting exchange rates, work incentives, investment, energy costs and availability, etc.), sector-specific policies (e.g., credit subsidies, import or export taxes on inputs or final products), infrastructure (for storage and transportation), and supporting institutions (e.g., credit, regulatory, news and information, etc.) that help markets to work effectively. Export shares and growth trends also depend on domestic demand, relative returns to other crops, and other conditions.

However, in its simplest terms, international market competitiveness is the ability to deliver a product at the lowest cost—i.e., with the lowest combined farm-level production, transportation, and marketing costs. On this basis, analysis of 1998/99 cost structures underlying soybean production, transportation, and marketing from principal growing regions to a common export destination, Rotterdam, suggests that the United States lags slightly behind Argentina and Brazil in soybean export cost competitiveness.

At the farm level, soybean producers in the U.S. “Heartland” had the highest overall average costs of production at \$5.11 per bushel, ranging from 18 to 25 percent above those of Argentine or Brazilian competitors.<sup>1</sup> Total production costs were lowest in Argentina’s central soybean growing region (southern Santa Fe and northern Buenos Aires Provinces) and in Brazil’s interior expansion zone (the State of Mato Grosso), at about \$3.90 per bushel in both regions.

<sup>1</sup> The Heartland is defined as western Ohio, Indiana, Illinois, Iowa, northern Missouri, western Kentucky, and parts of Nebraska, Minnesota, and South Dakota.

Production costs in Brazil’s coastal State of Parana (in Brazil’s traditional heartland) were estimated at \$4.16 per bushel. High imputed land costs in the United States account for much of the difference in overall production costs.

The U.S. production cost disadvantage is partially mitigated by internal transportation and marketing cost savings. In Brazil and Argentina, these costs are two to three times higher, on average, than in the United States, despite important efficiency gains in recent years. Freight charges to Rotterdam are also higher from South America. As a result, the delivered cost of Argentine and Brazilian soybeans at Rotterdam ranged from 2 to 12 percent less than U.S. costs in 1998/99.

## Methodology Behind the Cost Comparisons

The export cost competitiveness of U.S., Brazilian, and Argentine soybean producers is examined by comparing the components and distribution of farm-level production costs, the costs of internal marketing and transportation, and shipping costs to a common export destination. Cost data for each country were from local 1998/99 marketing years, the most recent year for which detailed comparisons were possible.

First, production costs were separated into their variable- and fixed-cost components. Variable costs include the use of inputs such as seed, fertilizer, chemicals, fuel, machine repair, interest on operating capital, and other direct costs incurred during crop production. Land costs—e.g., rental, maintenance, etc.—are not included with variable costs of production, but are combined with fixed production costs following ERS methodology that uses land rental rates to value the opportunity cost of all land farmed. Fixed costs include costs that are not directly tied to the production decision, such as land payments on prin-



farm to cargo vessel. Port prices are from the U.S. Gulf ports and the port of Rio Grande in Brazil.<sup>4</sup>

For Argentina, monthly farm-level prices were not available, so internal marketing and transportation costs were estimated in two steps. First, port and associated charges (including a 3-percent export tax) were estimated as the difference between f.o.b. port prices and f.a.s. (free alongside ship) Rosario terminal prices—reflecting port charges (loading, export tax, and quality control). Next, costs of bringing soybeans from farm to port were estimated using information from other sources on internal transportation charges at the average distance to port in 1998, plus estimates of other marketing costs (loading/unloading, and brokers' commission).<sup>5</sup>

The third factor affecting the competitiveness of U.S. and South American soybeans in export markets is the cost of bringing the soybeans from the point of embarkation to their export destination. These costs are estimated by examining the average monthly spread between f.o.b. port prices and the c.i.f. (cost, insurance, and freight) price at a destination port, in this case Rotterdam during 1995-99. The European Union is the world's largest importer of soybeans and soymeal—accounting for about 35 percent of global soybean imports and about 40 percent of soybean imports during the 1998 and 1999 marketing years—and Rotterdam is the leading port of entry for these products.

Table E-1 summarizes the production cost data on a per-acre and per-bushel basis, and table E-2 presents estimates of the overall "export cost" from the different production regions using a "landed" soybean price in Rotterdam—calculated by adding the estimated shipping charges and internal marketing and transportation costs to the farm-level costs of production for each country.

<sup>4</sup> Although other major ports in Brazil (e.g., Santos and Paranagua) lie closer to the production regions in Parana and Mato Grosso, a consistent series of f.o.b. prices was available only for the port of Rio Grande. Nevertheless, f.o.b. prices for Rio Grande should be reflective of f.o.b. prices at other ports in Brazil's South since they all lie in relatively close proximity to oceangoing cargo vessels.

<sup>5</sup> Estimates of freight and other charges from farm to port are based on data from the Brazilian oilseed crushing association (ABIOVE), cited in Verheijden and Reca (1998), and data provided by the Argentine brokerage firm Cortina-Beruatto (Frogone, 2001).

The comparisons made here are only rough indicators of competitiveness. Comparisons of farm-level costs of production, in particular, are difficult and potentially imprecise for a number of reasons. For example, the methods used to calculate costs vary considerably from country to country, with certain components of cost included by one country and omitted by others. In addition, cost estimates may be based on different production practices (such as single- or double-cropping, till or no-till production) or slightly different time periods (based on local growing seasons). Estimates are further complicated by exchange rate conversion issues, differences in financial versus economic accounting, the impact of policy distortions, and the fact that data reflect production and marketing costs for regions that bear different relationships to national averages in their respective countries. Data presented here may not correspond exactly with source data due to certain assumptions and the omission or reformulation of some data to make them as comparable as possible.

## Soybean Production Cost Structure Favors Argentina and Brazil

With their favorable natural resource endowments and climates, Argentina and Brazil are naturally low-cost producers of soybeans, giving them a strong competitive edge in international markets. Based on 1998 farm-level soybean production cost and yield data, total per-bushel costs in Brazil's Mato Grosso (\$3.89 per bushel) and Argentina (\$3.92 per bushel) were 23-24 percent lower than the U.S. Heartland's \$5.11 total cost per bushel. Production costs in Parana (\$4.16 per bushel) were 19 percent lower. Similarly, total per-acre soybean production costs were highest in the U.S. Heartland, averaging about \$235, some \$60-\$70 more than in Brazil and about \$35 an acre higher than in Argentina during 1998/99 (table E-1).<sup>6</sup>

The relatively high overall costs in the United States are attributable largely to high fixed costs of production, particularly the large imputed land costs faced by U.S. producers. This is especially true in comparison with Brazil, where estimated rental rates are just \$6 (in

<sup>6</sup> Total per-acre soybean production costs in the Heartland are slightly above the U.S. national average, largely reflecting higher land costs, but higher yields led to somewhat lower (about \$0.25/bushel) per-bushel costs of production than the national average. We exclude the opportunity cost of unpaid labor from the U.S. data. It is likely also excluded from Argentine and Brazilian data.

**Table E-1—Soybean production costs: United States, Brazil, and Argentina, 1998/99**

Cost item	U.S. Heart-land <sup>1</sup>	Brazil <sup>2</sup>		Argentina	
		Parana	Mato Grosso	N. BA / S. SF <sup>3</sup>	Chaco <sup>4</sup>
<i>U.S. \$ per acre</i>					
<b>Variable costs:</b>					
Seed	19.77	16.69	11.23	n/a	17.90
Fertilizers	8.22	20.66	44.95	n/a	0.00
Chemicals	27.31	20.56	39.97	n/a	16.90
Machine operation/repair	20.19	26.88	18.22	n/a	24.00
Interest on capital	1.81	5.63	12.11	n/a	n/a
Hired labor	1.29	22.72	5.58	n/a	4.30
Harvest	n/a	n/a	n/a	n/a	22.24
Miscellaneous	n/a	2.00	n/a	n/a	n/a
<b>Total variable costs</b>	<b>78.59</b>	<b>115.14</b>	<b>132.06</b>	<b>96.29</b>	<b>85.34</b>
<b>Fixed costs:</b>					
Depreciation of machinery/equipment <sup>5</sup>	47.99	41.04	8.97	19.08	
Land costs (rental rate)	87.96	14.28	5.84	62.72	
Taxes and insurance	6.97	1.63	0.55	n/a	
Farm overhead <sup>6</sup>	13.40	n/a	n/a	20.67	
<b>Total fixed costs</b>	<b>156.32</b>	<b>56.95</b>	<b>30.01</b>	<b>102.47</b>	
<b>Total production costs</b>	<b>234.91</b>	<b>172.09</b>	<b>162.08</b>	<b>198.76</b>	
<b>Yield (bushels/acre)</b>	<b>46.00</b>	<b>41.35</b>	<b>41.65</b>	<b>50.60</b>	
Variable costs per bushel	1.71	2.78	3.17	1.90	
Fixed costs per bushel	3.40	1.38	0.72	2.02	
Total costs per bushel	5.11	4.16	3.89	3.92	

<sup>1</sup> U.S. data are from ERS, USDA; <http://www.ers.usda.gov/data/costsandreturns/car/soybean2.htm>. The U.S. marketing year is September 1998 to August 1999. Data presented here exclude opportunity cost of unpaid labor. <sup>2</sup> Data for Parana are from USDA, FAS attache, *Annual Report 2000, Brazil: Oilseeds and Product* ("FAS-USDA 2000"), and from the Parana State Department of Agriculture (SEAB/DERAL). Data for Mato Grosso come from CONAB, GEAME, CUSTOS. Yield estimates are from FAS-USDA, 2000. Brazil's marketing year is February 1998 to January 1999. Producer price data are from the Fundacao Getulio Vargas, provided by CONAB. <sup>3</sup> Variable costs are average direct plus harvest costs for no-till, Roundup Ready soybean production in northern Buenos Aires/southern Santa Fe based on assumed yield (Source: *Margenes Agropecuarios*, January 1999). Land cost data are based on northern Buenos Aires Province rental rates (Source: *Margenes Agropecuarios*, July 1999). Other fixed costs for Argentina are adapted from 1991 data from Vieira and Williams (1996) based on the assumption that these fixed costs increased at the Argentine rate of (CPI) inflation between 1991 and 1998. Argentina's marketing year is April 1998 to March 1999. The Argentine producer price is based on the difference between f.o.b. port prices (SAGPyA) in October 1998, and the estimated costs of internal transportation and marketing (ABIOVE data cited in Verheijden and Reça, 1998; and Frogone, 2001). <sup>4</sup> Variable cost data for Chaco are based on suggested practices for conventional soybean planting techniques and are indicative of the relative importance of different inputs (Source: INTA, Argentine Ministry of Agriculture – SAGPyA). <sup>5</sup> In addition to depreciation, the U.S. figure includes interest on nonland capital, which amounts to approximately one-fifth of the \$47.99 total.

<sup>6</sup> For Argentina, this category includes maintenance on fixed capital.

Mato Grosso) to \$14 (Parana) per acre, compared with \$88 in the U.S. Heartland and \$63 for prime land in northern Buenos Aires Province. The particularly low rental rates in Brazil's Center-West reflect the abundance of *cerrado* soils still available for conversion into agricultural production. Recent reports indicate that high yielding land in Mato Grosso can still be purchased for as little as \$200 an acre, compared with over \$2,000 per acre in the U.S. Corn Belt.

Differences in land costs clearly play a crucial role in assessments of competitiveness based on overall production costs. For example, if land costs are excluded from overall production costs, the United States would rank ahead of Brazil, but still behind Argentina, in production-cost competitiveness.<sup>7</sup>

<sup>7</sup> Previous studies (Ortmann et al., 1989; Vieira and Williams, 1996) show similar results.

Based on variable costs alone, soybean growers in the U.S. Heartland are the low-cost producers. In Parana, greater fertilizer and labor costs (due to small-scale and labor-intensive production practices) inflate variable costs. In Mato Grosso, higher fertilizer and chemical costs (due most likely to higher prices rather than greater intensity of application) keep variable costs high.

Low expenditures on lime or fertilizers keep Argentine variable costs closer to U.S. costs. A previous ERS study (Trapido and Krajewski, 1989) also showed that the main Argentine producing Provinces (Buenos Aires and Sante Fe) had slightly higher variable costs per ton of production than the U.S. Corn Belt/Lake States, but another study (Ortmann et al., 1989) calculated per-ton variable costs to be slightly lower in Argentina.

Also favoring soybean farms in Argentina and Brazil's Mato Grosso is their much larger size (averaging over 1,000 hectares) relative to soybean farms in the U.S. Heartland (120-150 hectares) or Brazil's Parana (about 30 hectares)—where land is scarcer and a large class of landless or near-landless labor exists. Large farm size spreads overhead costs over more acres, resulting in much lower per-unit costs. As a result, average depreciation of machinery and equipment costs were significantly lower in Mato Grosso and Argentina than in the United States.

The United States had higher production costs than Parana throughout the 1990s. U.S. average soybean costs rose steadily from \$185 per acre in 1989 to \$235 per acre in 1998, slightly below the general pace of consumer inflation.<sup>8</sup> The increase was due mainly to rising fixed costs, particularly land. Increased chemical costs were responsible for a slight growth in variable costs.

However, fluctuations in the Brazilian currency render U.S. dollar-valued representations somewhat misleading. For example, in dollar terms, costs of production in Parana have fluctuated considerably in the last 10 years. After declining sharply from \$256 per acre in 1989 to \$134 in 1991, total costs of production rose again to \$169 per acre in 1992. Production costs ranged between \$158 per acre and \$205 per acre during 1993-98, before falling to a

<sup>8</sup> U.S. data prior to 1997 are for the North Central region, and for the newly defined Heartland in 1997 and 1998. Data for Brazil are from USDA, Foreign Agricultural Service, "Brazil Oilseeds and Products Annual report." various issues.

decade low of \$129 per acre in 1999 (according to just recently available data).

In local currency terms, however, total production costs in Parana rose nearly 30 percent between 1995 and 1999, so the apparent decline is largely a reflection of the weakening Brazilian currency, particularly after the real was allowed to float freely in international exchange markets. In Mato Grosso, most of the increase in total production costs between 1991 and 1998 (from \$99 to \$162 per acre) was due to higher chemical costs and interest on operating capital. Limited data from Argentina suggest that soybean producers there have had lower farm costs than U.S. producers throughout the 1990s.

### ***Internal Marketing and Transportation Costs are Lowest for United States***

The Brazilian and Argentine advantage in farm-level production costs was historically offset by much higher internal marketing and transportation costs. However, significant reductions in these costs since 1992 in Argentina and after 1996 in Brazil have boosted their soybean export competitiveness in recent years.

During 1998-99, internal marketing and transportation costs for soybeans destined for export averaged two to three times higher in Brazil and Argentina than in the United States, tending to dampen farmgate prices. Based on average farm-to-port distances, these costs averaged \$49 per metric ton (\$1.33/bushel) from Mato Grosso, \$31 per ton from Parana, and \$30 per ton for Argentine producers. In the United States, these costs amounted to just \$16 per ton. For producers in Mato Grosso, transportation and marketing costs were equivalent to one-quarter of the average f.o.b. port price during 1998.

These figures correspond with the combined freight-to-port and port charges estimated by ABIOVE (Brazilian vegetable oil industry association) for each country. According to ABIOVE, at the average distance to port, these charges totaled \$18 per ton for the United States and \$25 per ton in Argentina (including export taxes but not a broker's commission of \$2-\$5 per ton) in 1998. For Brazil, these charges were estimated at \$41 per ton.

Since the mid-1980s, the average U.S. producer-to-f.o.b. port price spread has remained relatively constant at \$16-\$18 per ton. In Argentina and Brazil, however, privatization and deregulation of railways

and ports, and the elimination or reduction of export controls have lowered transportation and marketing costs in recent years.

In Argentina, the margin between the terminal cash price at Rosario and the f.o.b. price of soybeans at Argentine ports has narrowed from an average of \$68 per metric ton during 1980-91, to just \$11 per ton since 1991. Nevertheless, farmgate-to-terminal transportation costs remain high due to a heavy reliance on trucking for bulk transport, high toll rates on private highways, and seasonal transportation bottlenecks.

In Brazil, similar internal cost reductions may have resulted in part from transportation infrastructure improvements, but also reflect the elimination (through rebates) of the 13-percent value-added ICMS tax on soybean exports in 1996. For Mato Grosso producers, whose soybeans must traverse roughly 1,500 kilometers to reach an east coast seaport, the producer-f.o.b. price spread averaged \$76 per ton from 1983 to 1997. Since 1997, they have averaged an estimated \$47 per ton. In Parana, where soybeans have a much shorter distance to oceangoing vessels, substantial internal cost reductions have also occurred as the producer-f.o.b. price spread has fallen from an average of \$52 per ton during 1983-97 to \$29 since 1997.

Lower transport and marketing costs for the United States reflect, in part, the efficient barge transportation system that can transport grains long distances at low cost. In Argentina and Parana, the fact that most soybean production takes place within 250-300 kilometers of ports has kept their costs significantly below those of Mato Grosso.

### *Shipping Charges to Rotterdam Favor United States*

The United States has a small advantage (\$0.11 per bushel) over Argentina and a somewhat larger one over Brazil (\$0.19 per bushel) in shipping charges to Rotterdam. This further narrows the export cost differentials when the combined production, marketing, and transportation costs are compared at the import destination of Rotterdam (table E-2).

The difference between the f.o.b. export price and c.i.f. import price spreads for the United States and South American countries is mostly attributable to distance (to Rotterdam), but may also reflect higher insurance rates and demurrage costs for ships originating from South American ports. With even greater relative distances to East Asian ports (e.g., Japan, South Korea, and China), Brazilian and Argentine soybean exports

**Table E-2—Hypothetical assessment of “export cost competitiveness,” 1998/99**

Cost item	U.S. Heartland \$/bu.	Brazil				Argentina Buenos Aires / Santa Fe	
		Parana \$/bu.	% of U.S. cost	Mato Grosso \$/bu.	% of U.S. cost	\$/bu.	% of U.S. cost
Production costs: <sup>1</sup>							
Variable costs	1.71	2.78		3.17		1.90	
Fixed costs	3.40	1.38		0.72		2.02	
<b>Total production costs</b>	<b>5.11</b>	<b>4.16</b>	<b>81</b>	<b>3.89</b>	<b>76</b>	<b>3.92</b>	<b>77</b>
Internal transport & marketing <sup>2</sup>	0.43	0.85		1.34		0.81	
<b>Cost at border</b>	<b>5.54</b>	<b>5.01</b>	<b>90</b>	<b>5.23</b>	<b>94</b>	<b>4.73</b>	<b>85</b>
Freight costs to Rotterdam <sup>3</sup>	0.38	0.57		0.57		0.49	
<b>Price at Rotterdam</b>	<b>5.92</b>	<b>5.58</b>	<b>94</b>	<b>5.80</b>	<b>98</b>	<b>5.22</b>	<b>88</b>

<sup>1</sup> Variable and fixed costs in each country are based on local marketing year costs in 1998/99 (see table 13).<sup>2</sup> Internal transport and marketing charges for Argentina are estimated as the sum of port charges [the spread between f.o.b. and free-alongside ship (f.a.s.) Rosario prices] and estimated transportation and other marketing costs. For Brazil, internal marketing and transportation costs are the average spread between farm prices and f.o.b. port prices during calendar years 1998 and 1999.<sup>3</sup> Freight costs are calculated as the average spread between f.o.b. port prices for each country and the c.i.f. port price in Rotterdam during calendar years 1995-99.

Sources: c.i.f. Rotterdam prices (*Oil World Weekly*); U.S. f.o.b. Gulf Port prices (AMS, USDA); Rosario f.o.b. and f.a.s. port prices (Argentine Ministry of Agriculture, SAGPyA); Rio Grande (Brazil) f.o.b. port prices (Safras & Mercado); U.S. farm prices received (NASS, USDA); producer prices in Parana and Mato Grosso (CONAB); Argentine transportation and internal marketing costs to port: Verheijden and Reça (1998) and Frogone (2001).

face a larger disadvantage (compared with the United States) in shipping rates to these destinations.

The gap between shipping rates from the United States and Brazil to Rotterdam has remained relatively constant over the last 15 years. But for Argentina, the average f.o.b.-to-c.i.f. price spread has narrowed from \$26 per ton during 1984-94 to \$18 per ton during 1995-99.

### Producer Revenues

With substantially higher total costs of production and similar yields, per-bushel and per-acre net revenues based strictly on a market price (ignoring LDPs, production flexibility contract payments, emergency supplementary income payments, and subsidized crop insurance) for U.S. Heartland soybean producers fall short of those for producers in Brazil and Argentina, assuming similar producer prices. However, higher internal transportation and marketing costs have depressed Brazilian producer prices to levels well below those in the United States. In October 1998, producer prices of \$4.81/bushel in Parana and \$4.58/bushel in Mato Grosso lagged the \$5.16/bushel received (excluding LDPs) in the U.S. Heartland. In Argentina, average producer prices were estimated at \$4.98/bushel in October 1998.<sup>9</sup>

Nevertheless, in 1998, estimated per-bushel and per-acre net producer returns in Argentina were the highest among the three countries, followed by Brazil and the United States. Argentine producers received an estimated \$1.06/bushel in 1998, compared with \$0.69/bushel in Mato Grosso, \$0.65/bushel in Parana, and just \$0.05/bushel in the U.S. Heartland.<sup>10</sup>

<sup>9</sup> Argentine producer prices were based on the difference between actual October 1998 f.o.b. prices (\$213/ton) and the estimated costs of internal marketing and transportation (\$30/ton).

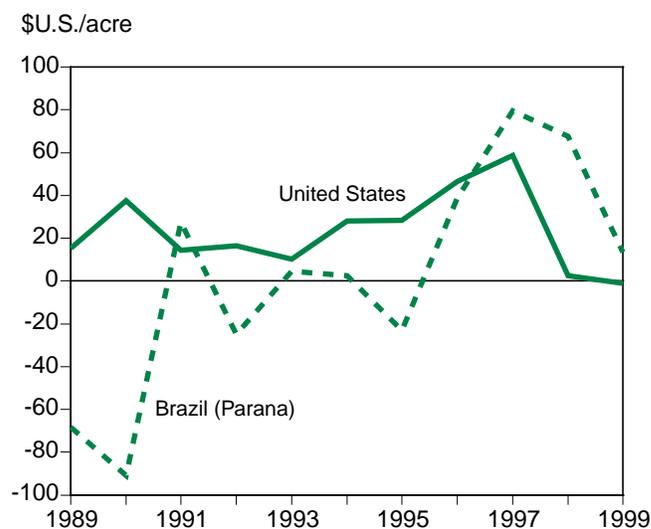
<sup>10</sup> The net revenue figure of 5 cents per bushel for U.S. Heartland producers is based on market prices only, and does not include potential extra revenue from marketing loan benefits. When prices are below the loan rate, U.S. producers can realize gross revenues above the loan rate of \$5.26 per bushel by receiving benefits under the marketing loan program early in the market year when prices are typically lowest, and then by selling their crop later in the marketing year when prices have risen. In the 1998 marketing year, for example, the weighted average marketing loan benefit (marketing loan gains and loan deficiency payments) for the soybean crop was \$0.44 per bushel. This benefit augmented the season-average price of \$4.93 per bushel, raising the average per-unit gross revenue for soybeans to \$5.37 per bushel, \$0.11 above the national soybean loan rate.

Despite relatively low market-based returns in 1998 and consistently higher costs of production in the United States than in Brazil, estimated per-acre net revenues from soybean production in the United States have actually exceeded those of producers in Parana over much of the past decade (fig. E-1). Between 1989 and 1996, per-acre net returns in Parana exceeded those of U.S. North Central/Heartland soybean producers only once, in 1991. From 1997 to 1999, however, net revenues in Parana surpassed those in the United States, and were especially strong in 1998.<sup>11</sup> Reduced internal transportation and marketing costs, as well as declining production costs (in dollar terms), have seemingly improved the bottom line for Brazilian producers since 1996. From limited data, it appears that net revenues in Mato Grosso have equaled or exceeded those in Parana during the 1990s, which is consistent with the trend toward increased production (and economies of scale) in that region.

<sup>11</sup> The trend comparisons made here are based on local harvest-period prices, rather than adjusting prices to the same month (October 1998) as done elsewhere in this analysis. In the U.S., average producer prices are from October; average March-May producer prices were used for Brazil. For the U.S., data prior to 1997 are for the North Central region, and for the newly defined Heartland in 1997, 1998, and recently available 1999 data.

Figure E-1

### Net farm revenues per acre of soybean production: United States and Brazil, 1989-99



Source: USDA; CONAB; IFS/IMF; authors' calculations

## **Conclusion: Argentina Appears Most Competitive**

Both Argentine and Brazilian soybeans have become more competitive in recent years due to declining internal marketing and transportation costs, including the reduction/elimination of export taxes on soybeans. Brazilian soybeans have also benefited from substantial currency depreciation since 1999.

In 1998/99, the underlying cost structures for producing, transporting, and marketing soybeans from Argentina's southern Santa Fe/northern Buenos Aires region and Brazil's two principal growing areas

allowed them to bring soybeans to Rotterdam at prices slightly below U.S. soybeans grown in the Corn Belt. These cost advantages help explain the rapid expansion of soybean production and soybean/product exports by Argentina and Brazil during the last decade.

In the future, increased soybean plantings by Argentina, holding other factors constant, may be restrained by limitations on the ability to expand total area devoted to agricultural production. In contrast, increased soybean production in Brazil's Center-West (e.g., Mato Grosso) appears especially promising, given abundant, inexpensive land available for cultivation.

# Outlook and Issues Confronting Future Development

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## Introduction

Although the Asian financial crisis temporarily reduced economic growth rates in South America during 1998-2000, virtually all of the region's economies are expected to register positive economic growth during the next decade. Growth prospects hinge on the outlook for the two largest economies in the region, Brazil and Argentina. Like many countries in South America, they are expected to continue to benefit from their successful evolution from semi-authoritarian political systems and managed economies to political pluralism and more market-oriented economies.

## Major Factors Governing Longrun Outlook

The positive long-term economic outlooks for both Argentina and Brazil are expected to carry over into their agricultural sectors, which should benefit from several factors common to their underlying structure (i.e., economic and institutional). These factors include:

- ◆ A growing predominance of large-scale commercial farms that are innovative, quick to adopt new technologies, and able to capture the economies of scale inherent in field crop production activities.
- ◆ Established marketing channels to international markets for most agricultural bulk commodities.
- ◆ Development of important internal waterways that could facilitate movement of bulk commodities.
- ◆ Multinational agribusinesses that have made significant investments in the agricultural sectors of both countries and that have a vested interest in the continued development of commercial agriculture.
- ◆ Large gaps in corn yields relative to the United States, which could enable significant productivity gains via more intensive use of agricultural inputs.

Brazil has four additional longrun factors that weigh in its favor. First, substantial undeveloped, but highly viable land remains available for agricultural production. Second, a strong domestic demand from a large, increasingly urbanized population is bolstered by an outlook for steady per capita income growth. Third, rapidly growing domestic poultry and pork sectors represent a robust source of demand for grains and protein meals. Finally, an extensive national agricultural research network that already has a proven track record, especially with soybeans, of successful varietal development and adaptation to tropical conditions.

At the same time, several factors could diminish agricultural prospects for Argentina and Brazil:

- ◆ Both countries rely predominantly on expensive overland truck transportation to move most bulk commodities to export positions. As a result, farm-gate-to-port charges will likely remain closely tied to fuel costs.
- ◆ Brazil's internal transportation and marketing infrastructure, and port facilities and operations, are still inefficient and costly, and will require substantial investment to support significant agricultural productivity growth.
- ◆ The Parana-Paraguay waterway's potential carrying capacity may be limited by environmental concerns and increasing traffic from Bolivia, Paraguay, and Mato Grosso do Sul.
- ◆ Both Argentina and Brazil still depend heavily on international markets as a source of demand, and have domestic storage capacity shortfalls limiting their ability to capture seasonal marketing opportunities.
- ◆ Both countries still have troublesome macroeconomic environments that include large public sector and agricultural debt. Brazil's agricultural sector debt was estimated at \$13 billion in 1999; Argentina's was over \$7 billion in 2000.

- ◆ Both countries have inadequate credit systems that limit domestic investment opportunities and hinder efficient resource management in their agricultural sectors.
- ◆ Argentina's currency is still partially tied to the strong U.S. dollar, which hurts Argentina's competitiveness with third countries.
- ◆ Argentina admitted to a recurrence of foot-and-mouth disease (FMD) in March 2001, after having just obtained FMD-free status. This bodes ill for the future of beef grain-finishing and unprocessed meat exports.

On balance, the outlook is positive. However, several "soft" assumptions underlie the current optimism, including a continuation of domestic macroeconomic stability in both countries, as well as continued global economic growth and trade liberalization.

### ***International Policy Developments Cloud Future Oilseed Trade Prospects***

Recent domestic policy shifts in China and the European Union (EU) are likely to alter the direction of international demand for oilseeds and their products. In addition, new farm legislation is slated for 2002 in the United States. As the world's leading producer and exporter of soybeans, any change in U.S. policy has immediate implications for international markets. Finally, further policy reforms under a new round of WTO trade negotiations, particularly new or stronger disciplines on domestic support, could influence oilseed and grain markets.

In 1999, China implemented a value-added tax (VAT) on soybean imports to promote the domestic vegetable oil processing sector. This favors imports of soybeans over soybean meal. A reversal of this policy dynamic is expected to occur upon China's accession to the World Trade Organization. Using the 1999 U.S.-China bilateral agreement as a likely formula for China's agricultural commitments, WTO accession would favor imports of vegetable oils over imports of beans and meal. The bilateral agreement established a tariff-rate quota (TRQ) of 1.72 million tons for soybean meal in 2000, which rises to 3.26 million tons in 2005. Within-quota imports would be subject to a duty of 9 percent, while above-quota imports would be assessed a duty of 74 percent in 2000, falling to 9 percent in 2006. The TRQ system for soybean meal would be eliminated by 2006 and converted to a bound 9-percent tariff rate. No quotas on soybeans and soybean meal were present prior to the bilateral agreement, and none were established

in the agreement. The crushing sectors of Argentina, Brazil, and the United States would all vie for increases in China's soybean meal and soybean demand.

The EU is the world's leading importer of soybeans and soybean meal. However, recent agricultural policy reform under Agenda 2000 is projected to slow growth in demand for soybeans and soybean meal through 2010 (USDA, 2001). Sharply lower internal support prices for cereals are expected to induce greater use of low-quality wheat in animal feed rations, trimming use of more expensive protein meals. The potential effect of Agenda 2000 policy changes is likely to be amplified by the continued weakness of the euro relative to the U.S. dollar. A weak euro favors consumption of domestically produced grains versus imported soybeans and soybean meal.

The policy debate surrounding the legislative agenda for the next U.S. farm bill has been underway for nearly a year. The current high support rate for soybeans relative to corn and other grains—as provided by the \$5.26-per-bushel loan rate—has engendered 4 consecutive years of record U.S. soybean plantings. U.S. and international market prices have declined to lows not seen since the early 1970s. If new legislation realigns commodity loan rates with their historic price relationships, U.S. soybean area could decline and prices strengthen.

Finally, further policy reforms under a new round of WTO trade negotiations, particularly new or stronger disciplines on domestic support, could influence oilseed and grain markets. The three members with the largest levels of agricultural support—the EU, Japan, and the United States—continue to provide large government outlays and price support programs. It is uncertain whether other WTO member countries will accept further liberalization without significant concessions on domestic spending from these three countries. Such concessions, in almost any form, would likely benefit Argentine and Brazilian producers.

### ***Producer Adoption of GMO Crops Could Have Market Implications***

Biotechnology, specifically genetic engineering, has launched speculation about the effects of the new technology on producer and consumer demand for genetically modified crops. Some biotech crops possess traits (e.g., insect resistance or herbicide tolerance) that can significantly reduce costs and risks for producers. However, consumer acceptance remains

uncertain, particularly in some major importing markets, like the European Union (EU), Japan, and Korea, where consumer and political groups have called for greater scrutiny over the use of biotech crops in the food chain.

While Argentine producers are aware of the restrictions on biotech products in some importing markets, such concerns have not deterred them from adopting biotech varieties. Approximately 90 percent of Argentina's soybean production is from biotech varieties, and producers are clearly motivated by the savings generated by herbicide-tolerant soybean varieties as well as the environmental benefits from using less damaging chemicals. Cost savings attributable to biotech soybeans are estimated at about \$40 per metric ton, significantly larger than the \$8-per-ton premium received by producers for nonbiotech soybeans in Argentine markets (FAS, USDA, "Argentina Oilseeds and Products Annual report," 2001).

In contrast to the United States, herbicide-tolerant soybeans have not been patented in Argentina. As a result, Argentine producers are not charged technology fees to use the seed, and farmers are allowed to save seeds from one year to the next. Consequently, seed costs for biotech soybeans are significantly lower in Argentina than in the United States.

Argentine farmers have been slower to adopt biotech corn hybrids. An estimated 20 percent of the 2001 corn crop is planted to insect-resistant (Bt) corn hybrids, all of which are approved by the EU. Since 1998, Argentina has approved only new corn hybrids that are accepted in major export markets.

Given Argentina's current adoption rates of both corn and soybean biotech varieties, and a lack of sufficient storage capacity under an identity preservation (IP) system, the additional costs of implementing an IP system would limit the potential for Argentina to capture a market niche for nonbiotech corn or soybeans. However, the situation is quite different in Brazil, with respect to soybeans, where the isolated Center-West region can make a much stronger claim to biotech-free status.

In Brazil, the Government (GOB) currently prohibits commercial planting of genetically modified crops. However, the cost savings available to biotech soybeans likely contribute to a significant illicit flow of biotech seeds from Argentina into Brazil's South, where the climate is fairly similar. The share of

biotech soybean plantings in the South has been estimated by various trade sources at between 20 to 40 percent. Although Brazil's corn crop appears to be predominantly nonbiotech, other nonbiotech producers such as South Africa and Eastern Europe would likely provide stiff competition for any future international market niche.

Approval for the commercial planting of biotech crops in Brazil is presently tied up in court. However, in late 2000 the GOB established the legal underpinning for the official biosecurity committee, the CTNBio, to make such decisions ((FAS, USDA, "Brazil Oilseeds and Products Annual report," 2001)). The government has also granted field trials on about 800 biotech projects—90 percent devoted to improving tropical corn varieties (Taylor, 2001).

Livestock markets also could be affected by biotech developments, particularly the potential use of biotech feed grain varieties in animal feed. While there is no scientific evidence that meat produced from biotech feed grains is in anyway unsafe or different from "nonbiotech" beef, consumer concerns and preferences could combine to generate a market premium for grass-fed beef. In such a market, Argentina and Brazil would compete for any niche premiums with ample grass-fed supplies from Australia and New Zealand.

### ***Issues Surrounding the Longrun Outlook for Brazil***

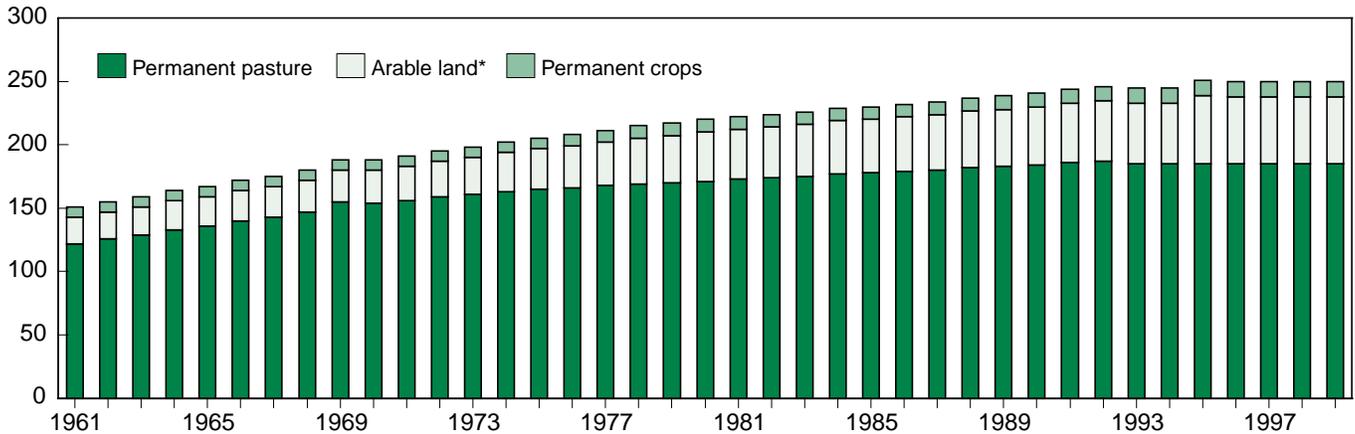
Brazil's agricultural production prospects are extremely favorable in the long term, and are based principally on continued expansion of the agricultural land base (fig. F-1). Brazil still lays claim to substantial tracts of fairly accessible, potentially productive virgin scrubland. The conversion of this undeveloped land to agriculture is expected to continue unabated through the next decade and beyond, leading to further gains in field crop area and in cultivated pastures to support livestock expansion.

The low international commodity prices of the past 3 years have likely slowed land conversion in the Center-West, but several factors suggest its resumption. First, there appear to be very low opportunity costs to bringing new land under production. Second, the promise of infrastructure development in the Center-West suggests higher land prices in the future, making land investment appear profitable. Third, investment in land remains a useful hedge against the threat of inflation which, although greatly reduced

Figure F-1

**Brazil's agricultural land use pattern, 1961-99**

Mil. hectares



\*Arable land refers to land under cultivation or in a cropping rotation.

Source: FAO, FAOSTATS.

from past levels, has not entirely disappeared. Finally, internal demand for soy meal and feed grains is destined to grow as Brazil's large poultry and pork industries respond to surging domestic and international demand.

Perhaps most important to future land expansion is the pace at which Brazil improves its transportation infrastructure, particularly into the interior. Waterway and railroad improvements, as they occur, are expected to make more agricultural production accessible to export terminals at competitive prices. Projects already underway are beginning to have an impact, particularly the Madeira-Amazon route designed to move west-central Mato Grosso soybeans via a waterway from Porto Velho to oceangoing vessels coming up the Amazon. But many questions remain. How fast will investment move into infrastructure development? Will the level and pace of investment in the transportation and market infrastructure be sufficient to support an expanding soybean industry? Are public or private credit limitations a potential bottleneck?

In addition to transportation infrastructure, new investment is needed in storage and handling facilities along the marketing chain, and in port facilities. Despite improving Brazilian port loading and handling infrastructure, charges remain high relative to Argentine and U.S. ports.

Continued land expansion raises concerns about long-term agricultural productivity, particularly in a humid tropical setting with its potential for disease and pest problems. Will plant breeding keep pace with the expansion into new areas? The GOB's EMBRAPA and privately funded research groups appear poised to push agricultural research forward. However, intellectual property rights are clearly an issue. Widespread "brown-bagging" of existing technologies reduce private research incentives.

As more productive land in the Center-West comes under cultivation, national average yields and production of soybean, cotton, and corn should increase. The share of new land development dedicated to soybeans will depend on two principal factors: production financing and relative market prices. Soybean producers generally receive considerable support from buyers, while cotton producers receive extended payment terms on input purchases from suppliers. In contrast, corn production receives little support from either buyers or input suppliers. As a result, soybeans and cotton are given preference by Brazil's growers over summer-crop corn (November-April). Safrinha, the winter-crop corn (February-August), is more widely grown in the Center-West as a second crop. However, it is a high-risk venture that attracts minimum investment (e.g., fertilizer use) due to the lack of dependable winter rainfall in the region.

Growing domestic food, feed, and industrial demand for corn have generated strong price incentives for corn relative to soybeans. In Mato Grosso, the soybean-to-corn producer price ratio averaged 1.75 from 1982 through 2000 compared with 1.9 in Parana (fig. F-2). While different cost structures make direct comparisons of regional price ratios less meaningful, the soybean-to-corn price ratio in the United States has averaged slightly over 2.5 since 1982. High corn yields in the U.S. explain much of the difference in price ratios.

The future of Brazil's corn industry hinges on the success of tropical corn varieties. Anecdotal evidence suggests that yields of 150-160 bushels per acre are not uncommon on the large commercial farms of the Center-West (compared with a U.S. national average of 130-135 bushels/acre). Further yield gains could stimulate the Brazilian corn industry. However, high-yielding corn's heavy dependence on fertilizer and other inputs makes it a considerably more expensive and risky alternative to soybeans and cotton.

Brazil's agricultural sector is rapidly modernizing, driven in part by private agricultural research. Meanwhile, a broader-based increase in per capita incomes is expected to boost consumption of livestock products, which translates directly into increased demand for feed grains and protein meals. Similarly, continued success in exporting beef, pork, and poultry will also increase Brazil's domestic absorption of feedstuffs. In addition, improvements in infrastructures and market delivery systems will generate efficiency gains

and greater profitability. Continued profitability in the grain and oilseed sectors will eventually be capitalized into land values, thereby raising operating costs and restraining competitiveness. However, the tremendous extent of Brazil's untapped land base and the huge pool of unskilled and semi-skilled labor suggest a cost structure advantage that should endure well into the future.

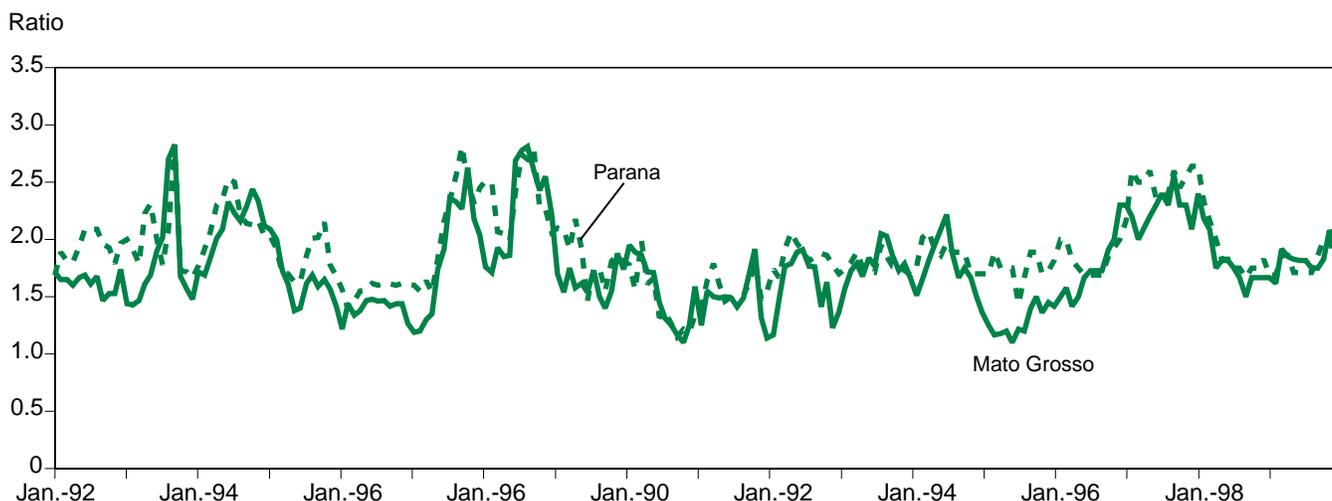
### *Issues Surrounding the Longrun Outlook for Argentina*

Most arable land in Argentina is already integrated into the agricultural sector. Corn, soybeans, and wheat must compete with pasture land as well as minor oilseed and coarse grain crops. A continuation of expanding field crop harvested area in Argentina—up over 16 percent from 1995 to 1996 (to a then-record 23.1 million hectares), and rising to an estimated 24.4 million hectares in 2001—hinges on several factors. Will further reductions in field crop abandonment occur? Are further increases in second-crop soybeans likely? How likely are further shifts away from the traditional crop-livestock rotation? Will marginal shifts out of permanent pasture and into field crop cultivation continue? Are further cost savings available from transportation and marketing improvements? Is further yield growth likely? Finally, is a *bona fide* currency devaluation imminent and what effect would it have on export competitiveness?

At first glance, it would appear that Argentina's expansion in crop area has about run its course.

Figure F-2

#### **Ratio of soybean-to-corn producer prices: Mato Grosso and Parana**



Source: Fundacao Getulio Vargas.

Abandonment rates for feed grains and soybeans in Argentina are still above U.S. levels, while the Argentine abandonment rate for wheat planted area is below the U.S. rate. To the extent that Argentine producers can replicate U.S. abandonment rates, some modest decline in abandonment rates for corn, sorghum, and soybeans is achievable. However, barring any new and dramatic genetic breakthroughs, double-cropping of soybeans appears to be near a maximum sustainable level at about 2.4 million hectares, with little room left for anything but marginal expansion.

Relative prices will continue to determine the land mix among wheat, corn, soybeans, other coarse grains, oilseeds, and pasture land. However, livestock dynamics will be critical in the evolution of Argentina's field crop area. In 1999, only about 10 percent of beef production was finished in feedlots. Any shift in incentives to spur feedlot development and grain finishing could move more pasture land to row crop production. A shift of just 1 percent to cropland from Argentina's 142 million hectares of permanent pastureland (FAO) would result in a 5-percent increase in area planted to row crops (fig. F-3).

Growth in demand for higher grades of red meat in international markets—generally a function of income growth—may spur greater investment in feed lots and grain feeding in Argentina. Reforms have already set

the stage for just such a stakeoff. In 1990, the Argentine National Animal Health Service initiated a comprehensive foot-and-mouth disease (FMD) vaccination program. The presence of FMD had resulted in an effective ban of Argentine fresh and frozen beef from world markets. By August 1997, there had been no outbreak of FMD in over 3 years. At that time the United States announced that it would begin importing fresh boneless beef from Argentina under a 20,000-ton quota after more than a 60-year prohibition.

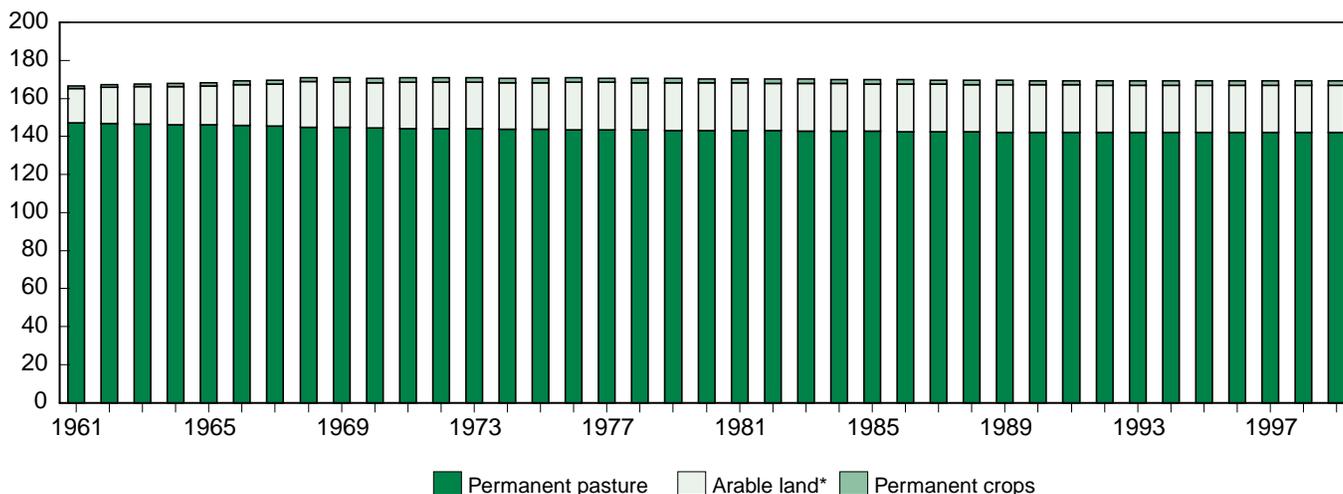
In 2000, Argentina attained FMD-free status, but in March 2001, the GOA confirmed a widespread outbreak of FMD, forestalling any potential meat-export takeoff and suggesting that more price weakness in the livestock sector could foreshadow further field crop gains.

Improvements in Argentina's transportation/marketing infrastructure and the transmission of international prices since economic reforms and privatization have translated into improved farmgate prices for the more export-oriented field crops. Certainly this development has contributed to Argentina's dramatic acreage expansion of recent years. Argentina's transportation infrastructure, which has largely been privatized, continues to be upgraded to handle the expanding supply of agricultural products. However, most of the price savings from transportation improvements are likely played out. The condition and throughput capacity of inland

Figure F-3

### Argentina's agricultural land use pattern

Mil. hectares



\*Arable land refers to land under cultivation or in a cropping rotation.

Source: FAOSTATS, FAO.

## USDA's Longrun Baseline Projections

USDA annually provides long-run baseline projections for the U.S. agricultural sector. The most recent projections, *USDA Baseline Projections to 2010* (USDA, February 2001), cover 2001 through 2010 and include projections of international trade in major agricultural commodities and a discussion of the economic behavior (production, consumption, and policy) underlying those trade projections. These projections were completed in October 2000 based on policy decisions and other information known at that time.

USDA's 2001 baseline projections were completed prior to the research that underlies this report. As a result, they do not incorporate all of the forward-looking information presented in this report. In particular, the projections assume only modest

growth (under 1 percent per year) in total gross cropped area in Brazil. In addition, recent developments in Brazil's corn and cotton sectors are noticeably absent from the 2001 projections. As a result, USDA's 2001 baseline projections may be viewed as a conservative projection of field crop growth potential in Brazil.

Higher total gross cropped area expansion rates will be tested in simulations of the ERS Country Linker System of models and presented as part of the 2002 USDA baseline exercise (forthcoming, February 2002).

Interested readers should refer to the ERS website at <http://www.ers.usda.gov/Briefing/Baseline/> for further information concerning USDA baseline activity and a detailed description of the assumptions and projections.

roadways appears to have improved under privatization, but expensive tolls have offset savings from fewer delays and truck breakdowns.

Port charges in Argentina are now on par with those of the United States. Privatization of inland transportation has improved waterways and lowered costs, but the Parana-Paraguay waterway must also continue to serve expanding grain and oilseed shipments from Paraguay, Bolivia, and Mato Grosso do Sul.

Although the potential for field crop expansion appears limited, especially compared with Brazil, Argentina can still increase its corn production through yield growth. Input-use levels lag U.S. and Brazilian rates. The agricultural sector is heavily indebted, and high interest rates and low agricultural prices have farmers in a cost-price squeeze that inhibits increased input use. Varietal improvements and seed development for corn will also be critical to closing the yield gap.

A final uncertainty related to Argentina's longrun competitiveness is its convertibility regime, which had pegged the peso to the U.S. dollar on a one-to-one exchange rate. It is surprising how competitive Argentina has remained in international export markets, despite the implicit tax on exports associated with the currency's link to the strong U.S. dollar.

Argentina's recent macroeconomic difficulties have eroded international confidence in the Argentine economy. In addition, Argentina's current economic

outlook suggests renewed inflation. After negligible inflation during 1996-2000, inflation is projected to be 6 to 10 percent during 2002 and 2003 (DRI-WEFA, May 2001). If inflation in Argentina outpaces that in the United States and international confidence erodes, the peso will again become overvalued (barring any unforeseen devaluation). The Argentine Government has been under some pressure (both politically and economically) to change its currency alignment back to a pegged-float or a free-float. Although the outcome is uncertain, a devaluation of the peso would clearly improve Argentina's competitiveness vis-à-vis the United States.

### *Longrun Projections for Brazil*

Under USDA's 2001 long-term projections, Brazil's continued soybean area expansion and production gains result in annual soybean export growth of 4 percent, from an estimated 10 million tons in 2000 to over 15 million tons by 2010 (table F-1; fig. F-4). World soybean exports are projected to grow at 1.3-percent, implying significant market-share gains by Brazil—from 22 percent in 2000 to 29 percent in 2010. Brazil exhibits similar strong growth in soybean product trade, increasing its share of world trade in soybean meal and soybean oil from 26 and 17 percent in 2000 to 28 and 23 percent in 2010.

Area planted to wheat in Brazil shows little or no growth through 2010. The temperate South faces more efficient wheat production from neighboring Argentina, and current varieties of wheat are not

**Table F-1—USDA baseline trade projections, major field crops, Argentina and Brazil, to 2010**

Trade	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	Growth rate <sup>1</sup>
	<i>Million metric tons</i>										<i>Percent</i>
<b>Soybean</b>											
Argentina exports	3.7	3.4	3.2	3.3	3.3	3.3	3.3	3.3	3.1	2.9	-2.6
Brazil exports	11.1	11.3	11.3	11.7	12.3	13.0	13.4	14.2	14.5	15.3	4.0
World exports	47.1	47.8	48.4	48.9	49.2	49.9	50.4	51.5	51.8	52.7	1.3
<b>Soy meal</b>											
Argentina exports	15.3	15.5	15.8	16.0	16.6	16.6	17.1	17.4	17.9	18.4	2.4
Brazil exports	10.4	10.6	10.8	11.2	11.3	12.2	12.6	13.1	13.7	14.2	3.5
World exports	41.4	42.3	43.2	43.9	44.7	45.8	46.8	47.9	49.1	50.3	2.3
<b>Soy oil</b>											
Argentina exports	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.9	2.5
Brazil exports	1.4	1.4	1.5	1.6	1.7	1.9	1.9	2.1	2.2	2.3	6.1
World exports	8.0	8.2	8.5	8.7	8.9	9.1	9.2	9.4	9.7	9.9	2.5
<b>Rice</b>											
Argentina exports	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.9	1.0	1.0	8.8
Brazil imports	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	3.4
World exports	25.0	25.5	26.0	26.5	27.1	27.6	28.2	28.7	29.3	30.0	1.9
<b>Wheat</b>											
Argentina exports	10.5	10.7	10.9	11.1	11.2	11.5	11.7	11.8	12.0	12.0	1.3
Brazil imports	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	9.1	1.8
World exports	102.7	105.1	107.3	109.0	110.6	112.5	114.8	117.3	119.7	122.1	1.7
<b>Corn</b>											
Argentina exports	9.7	10.5	11.6	12.3	13.2	14.0	15.0	15.5	16.0	16.5	6.6
World exports	73.5	74.5	75.9	78.0	80.1	82.9	86.0	89.3	91.9	94.6	2.8
<b>Sorghum</b>											
Argentina exports	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.3	0.3	-7.8
World exports	7.7	7.7	7.7	7.7	7.8	7.9	9.1	8.3	8.5	8.8	2.5
<i>Million bales</i>											
<b>Cotton</b>											
Argentina exports	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	3.2
Brazil imports	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.3	1.3	1.3	2.8
World imports	28.4	28.8	29.0	29.3	29.6	29.9	30.3	30.7	31.1	31.6	1.3

<sup>1</sup>Annual marketing year growth rate based on log-linear regression on trend.

Source: *USDA Baseline Projections to 2010* (USDA, February 2001).

economical in the tropical setting of the country's interior. As a result of limited wheat production growth in the face of strong urbanization and income growth, Brazil's wheat imports are expected to grow at about 1.8 percent annually, reaching 9.1 million tons by 2010. This import level maintains Brazil as the world's leading wheat importer throughout the projection period. Domestic rice production also fails to keep pace with rapidly growing domestic demand. As a

result, rice imports grow at a 3.4-percent annual rate to over 1.1 million tons by 2010.

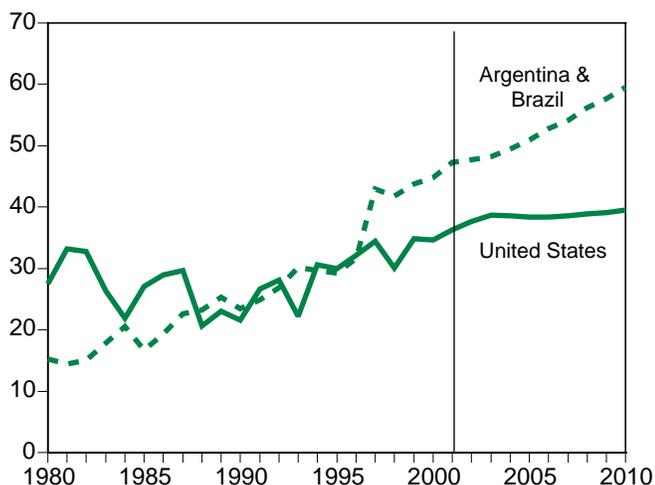
Despite recent signals that Brazilian cotton production is prepared for a dramatic takeoff in the Center-West, its realization is not reflected in baseline projections. Instead, cotton imports are expected to continue to grow throughout the projection period (table F-1).

Brazil's livestock sector is projected to show very robust growth through 2010, resulting in expanding

Figure F-4

**Soybean and product exports from Argentina and Brazil are projected to continue growth through 2010**

Mil. metric tons



Historical (1980-2000) and projected (2001-10) exports of soybean and soymeal as soybean equivalents.

Source: *USDA Agricultural Baseline Projections to 2010*.

exports for poultry, pork, and beef. Poultry exports are expected to rapidly grow at a 3.6 percent annual rate, followed by pork exports at 2.8 percent annual growth, and beef exports at 1.8 percent annual growth (table F-2). While much of the growth in beef exports likely results from continued expansion of Brazil’s permanent pastureland, expanding poultry and pork exports imply increased feeding of corn and protein meals.

**Longrun Projections for Argentina**

Under USDA 2001 baseline projections, Argentina’s production of corn, soybeans, and wheat expands through 2010. Area continues to shift out of sorghum, barley, and minor coarse grains, as well as sunflower and minor oilseeds, and into corn and soybeans (a pattern that dominated the last half of the 1990s). Wheat area remains fairly stable. Yields of wheat and corn are expected to grow only modestly due to a continuation of limited input use. Argentina could rapidly close the gap in corn yields with the United States via more intensive input use, but this is not expected under the baseline assumptions.

As a result of the acreage shifts, Argentina’s corn exports grow 6.6 percent annually from 2000 to 2010, whereas sorghum exports decline by nearly 8 percent per year (table F-1). Argentina continues to emerge as a corn

exporter during the projection period, particularly after 2005 when China’s net corn exports are projected to end. Argentina’s share of world corn exports grows from 12 percent in 2000 to 17.4 percent by 2010 (at 16.5 million tons of exports), becoming the world’s second-largest corn exporter behind the United States. Argentina’s wheat exports grow 1.3 percent annually, reflecting stable area and only gradual yield growth. However, this growth is still sufficient to maintain a global market share of 7.5 percent throughout the projection period.

Argentina’s soybean area and production growth are expected to slow substantially through 2010, while soybean yields rise only marginally. As a result, Argentina refocuses its export emphasis from soybeans to products—soymeal and soyoil—to capture a greater share of the value-added from crushing. Soybean exports decline 2.6 percent annually, falling from 4.5 million tons in 2000 to only 2.9 million tons in 2010, while soymeal and soyoil exports expand 2.4 and 2.5 percent annually. As a result, Argentina’s share of world soybean trade declines from 10 percent in 2000 to under 6 percent in 2010, whereas its soymeal and soyoil exports are expected to hold fairly steady at 37 and 39 percent.

Argentina’s beef and veal production and exports are projected to grow at a 1.4 percent per year during the baseline period (table F-2).

Rice area in Argentina expands—mostly in the traditional rice-growing Provinces of Entre Rios and Santa Fe—to mid-1990s levels under strong international market incentives. The growth in production is destined almost entirely for the international market—principally Brazil—as Argentina’s rice exports more than triple to just over 1 million tons in 2010, up from only about 275,000 tons in 2000.

Argentina’s cotton area also expands, principally in the northern Provinces of Chaco and Santiago del Estero where the hotter, wetter (almost tropical) climate favors cotton production over most other field crops. As with rice, the additional cotton production is moved into international markets—also predominantly Brazil—at a growth rate of 3.2 percent. Exports reach about 800,000 bales by 2010.

**Conclusions**

Field crop producers in Argentina and Brazil have expanded crop area and output substantially in the past 5 to 10 years at unsubsidized prices and without the

**Table F-2—USDA baseline trade projections, livestock products, Argentina and Brazil, to 2010**

Trade	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Growth rate <sup>1</sup>
	<i>Million metric tons</i>										<i>Percent</i>
<b>Beef</b>											
Argentina exports	390	399	408	418	417	417	417	424	427	431	1.4
Brazil exports	675	699	742	774	766	763	752	760	772	782	1.8
Major exporters	5,296	5,468	5,607	5,741	5,807	5,900	5,994	6,085	6,172	6,258	1.9
<b>Pork</b>											
Brazil exports	100	102	104	106	110	112	114	116	118	120	2.8
Major exporters	3,103	3,065	3,025	3,087	3,145	3,232	3,289	3,349	3,412	3,480	1.5
<b>Poultry</b>											
	<i>1,000 metric tons, ready to cook</i>										
Brazil exports	986	987	991	1,002	1,501	1,103	1,160	1,210	1,264	1,296	3.6
Major exporters	6,218	6,356	6,460	6,579	6,738	6,912	7,061	7,206	7,352	7,480	2.1

<sup>1</sup>Annual calendar year growth rate based on log-linear regression on trend.

Source: *USDA Baseline Projections to 2010* (USDA, February 2001).

benefit of loan deficiency payments, subsidized crop insurance, production flexibility contract payments, or emergency supplemental income payments. Increased South American supplies have no doubt contributed to the low agricultural commodity prices of recent years, which have squeezed market returns in the United States and triggered large government payments to the U.S. agricultural sector. So, how will U.S. field crop producers remain competitive as land values continue to rise (due, in large part, to the capitalization of record government payments), while Brazil and Argentina

continue to lower transport and marketing costs and/or benefit from a depreciating currency?

Clearly, the tremendous potential for further growth of South American field crop output, if realized, could have profound implications for global trade and U.S. farm exports, prices, and incomes. The impact on future U.S. budgetary outlays under current farm programs and on options for future farm legislation could also be profound.

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